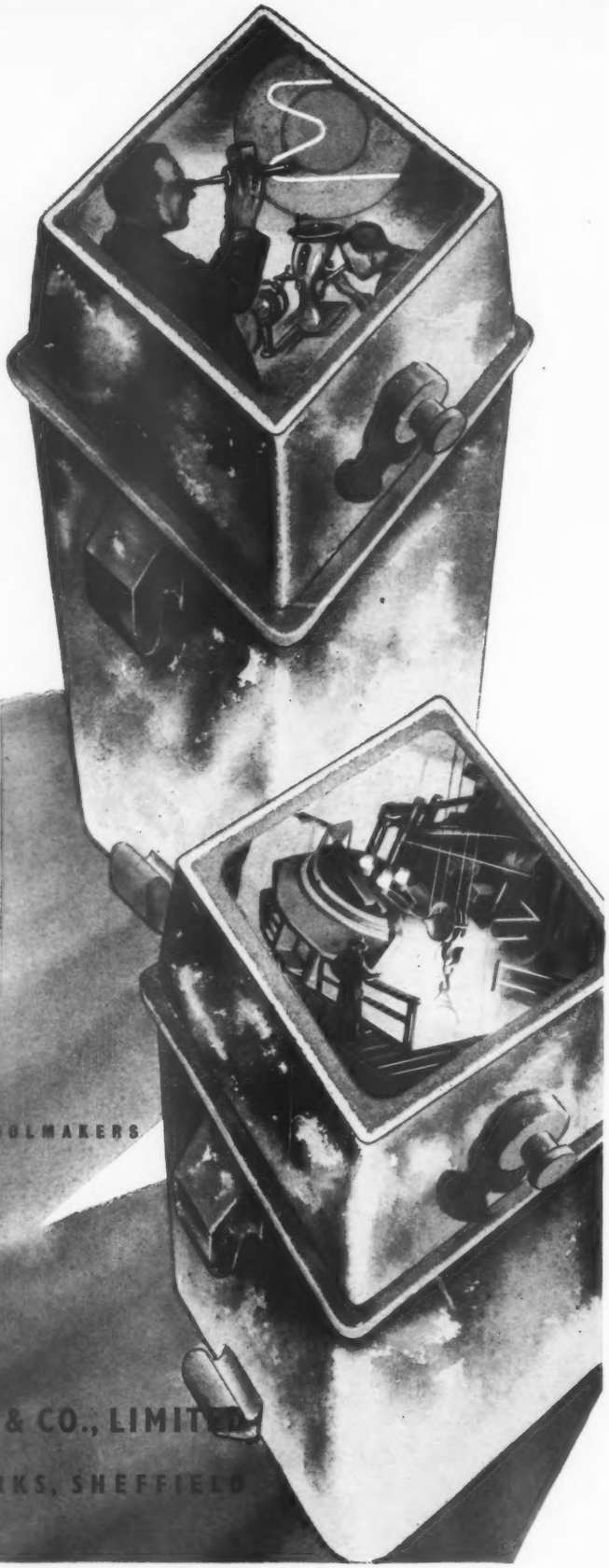
Mechanical World

AND ENGINEERING RECORD

Monthly: Two Shillings and Sixpence Established 1876 MAY, 1960

IN EVERY INGOT . . .



. . . cast from the furnaces of the *Osborn* group of Companies, cumulative experience from generations of craftsmanship is combined with modern research and technology to produce steel of superlative quality. A wide range of high-speed and other special tools steels is manufactured and many other products including steel casting, forgings and engineers' cutting tools are produced within the same organisation.

STEELMAKERS

STEELFOUNDERS

ENGINEERS' TOOLMAKERS

OSBORN

SAMUEL OSBORN & CO., LIMITED

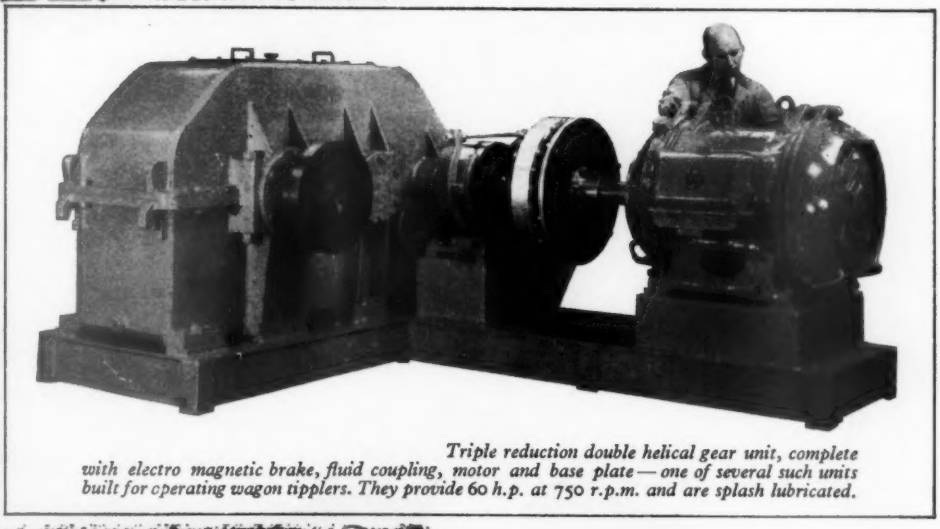
CLYDE STEEL WORKS, SHEFFIELD

for the design and production of SPECIAL GEAR UNITS

Superb facilities are available at Angus Gear Division for the design and manufacture of gear units of all kinds to meet every industrial need.

An unusually complete service in this field, outstanding in its scope and quality, is the result of an accumulation of experience and valuable technical skill, allied to one of the most advanced gear cutting plants in Europe.

We shall be pleased to discuss your gear requirements

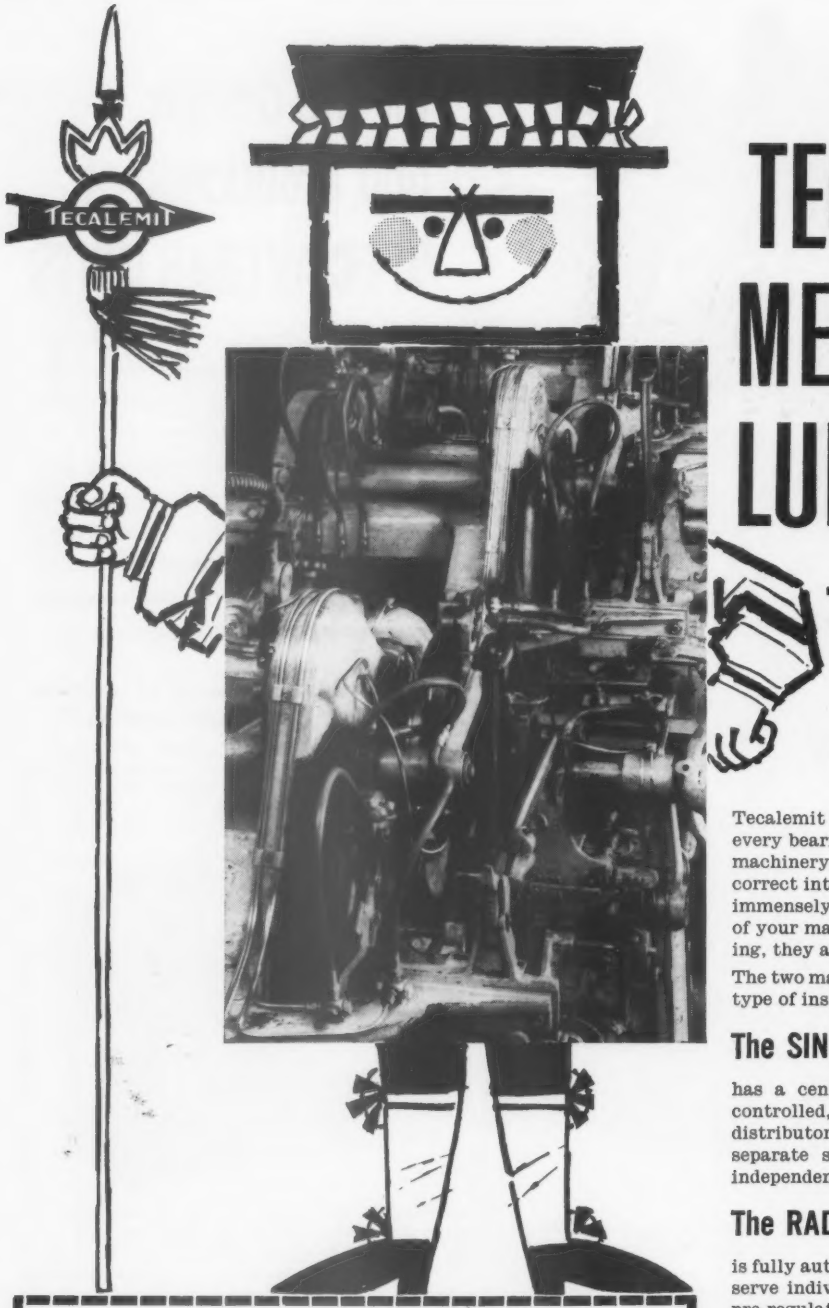


Triple reduction double helical gear unit, complete with electro magnetic brake, fluid coupling, motor and base plate — one of several such units built for operating wagon tipplers. They provide 60 h.p. at 750 r.p.m. and are splash lubricated.

Also in regular production are:

SPUR AND HELICAL GEARS up to 78" diameter.
DOUBLE HELICAL GEARS up to 5 ft. diameter.
WORM GEARS up to 24" centres.
BEVEL GEARS up to 5 ft. diameter.
PROFILE GROUND SPUR, HELICAL AND WORM GEARS.
DURANGUS AND PEAK NON-METALLIC SILENT GEARS.
RAWHIDE SILENT PINIONS.
GAMAX GEARED MOTOR UNITS.
AUTORAM ELECTRO-MECHANICAL THRUST UNITS.

GEORGE ANGUS & Co LTD
GEAR DIVISION
PRINCE CONSORT ROAD, HEBBURN-ON-TYNE



TECALEMIT MECHANICAL LUBRICATION

The guardian of your machines

Tecalemit Mechanical Greasing Systems guard every bearing. Fitted into new designs or existing machinery, they ensure correct greasing at the correct intervals, eliminate neglect and error, and immensely increase the working life and efficiency of your machines. And by cutting out hand greasing, they add much to works safety.

The two main grease systems are suitable for every type of installation.

The SINGLE-LINE SYSTEM

has a central pump—fully automatic, operator controlled, or hand operated—and a single main distributor line, feeding each bearing through a separate single-line injector, each of which is independently regulated.

The RADIAL SYSTEM

is fully automatic, and uses 19 miniature pumps to serve individual bearings. Each pump's output is pre-regulated. The unit can be driven from the machine it serves, or supplied with its own electric motor.

Tecalemit Mechanical Lubrication can solve your problems and speed your production.

To Tecalemit Ltd. (Sales MEW) Plymouth, Devon

Fill in this coupon and post it today. If you have a particular application or trouble-spot in mind, by all means enclose a note, a sketch or a drawing. You will be under no obligation whatsoever.

Please send me full information on:—

- Tecalemit SINGLE-LINE Grease Injection systems ☐
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TECALEMIT

—the Authority on Lubrication

Tecalemit Limited (Sales EW), Plymouth, Devon.

T/712

You sir, have gearing problems?

Let us get our teeth into them

Almost a century ago, David Brown pioneered precision machine cut gearing and, ever since, the firm's history has been one of inevitable expansion.

To-day, in purposeful silence, David Brown gears actuate 'iron lungs' in our hospitals; drive great ships; and keep the wheels of practically every industry turning, smoothly and efficiently.

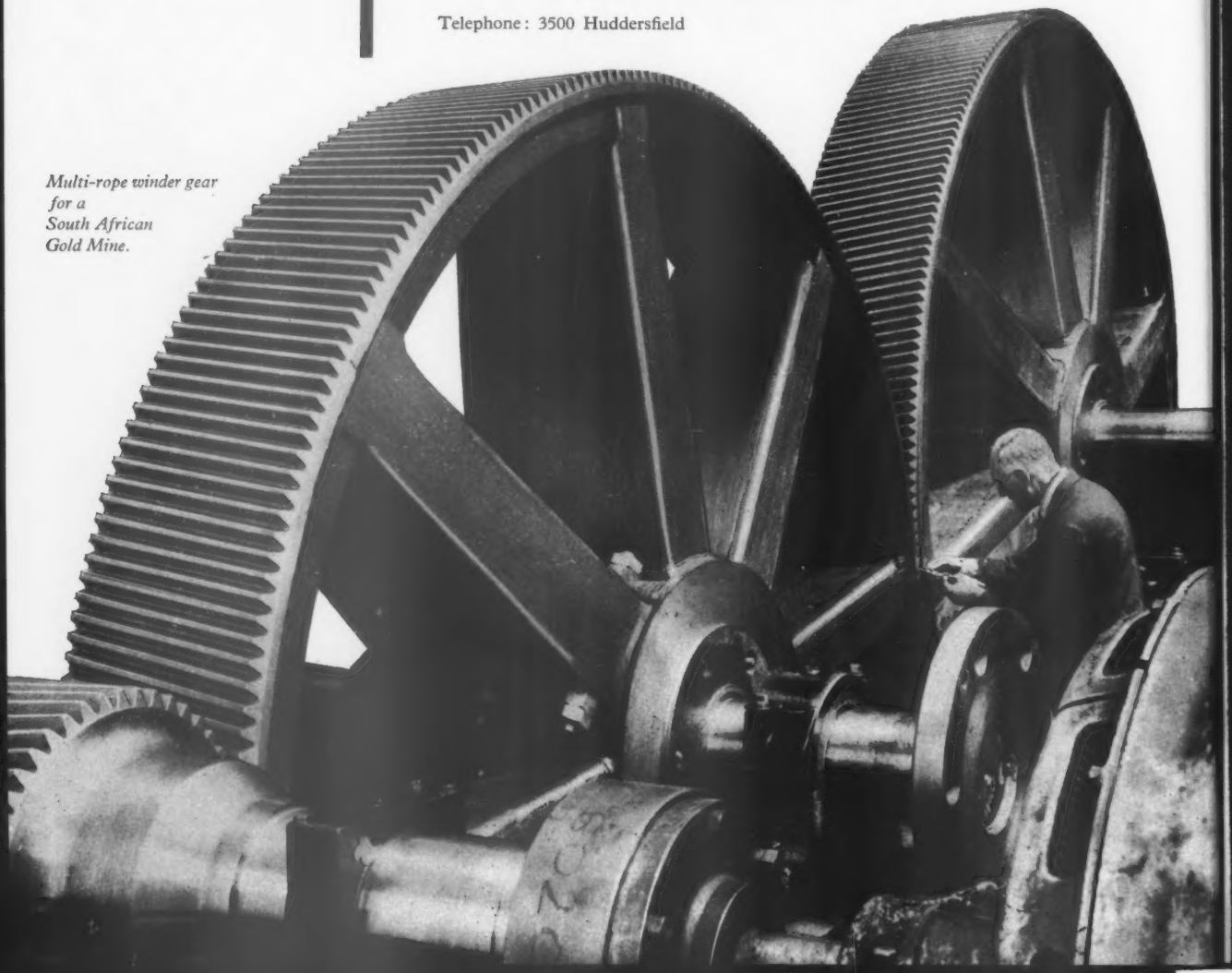
If your power input-over-output figure is too improper a fraction, consult the David Brown Group's Technical Advisory Service. It costs, and commits you to, nothing. But it can be very good indeed for your production.

DAVID BROWN

THE DAVID BROWN CORPORATION (SALES) LIMITED

GENERAL GEAR DIVISION, HUDDERSFIELD, YORKS., ENGLAND

Telephone: 3500 Huddersfield



Multi-rope winder gear for a South African Gold Mine.

RINGS and CIRCULAR DIE FORGINGS

Seamless Rings in Carbon and Alloy Steels. Flanges of all types. Gear Rings and other rings with square, rectangular or profiled cross section, from 6 inches (min. weight 70 lbs.) to 78 inches inside diameter and from 2 to 12 inches axial width.

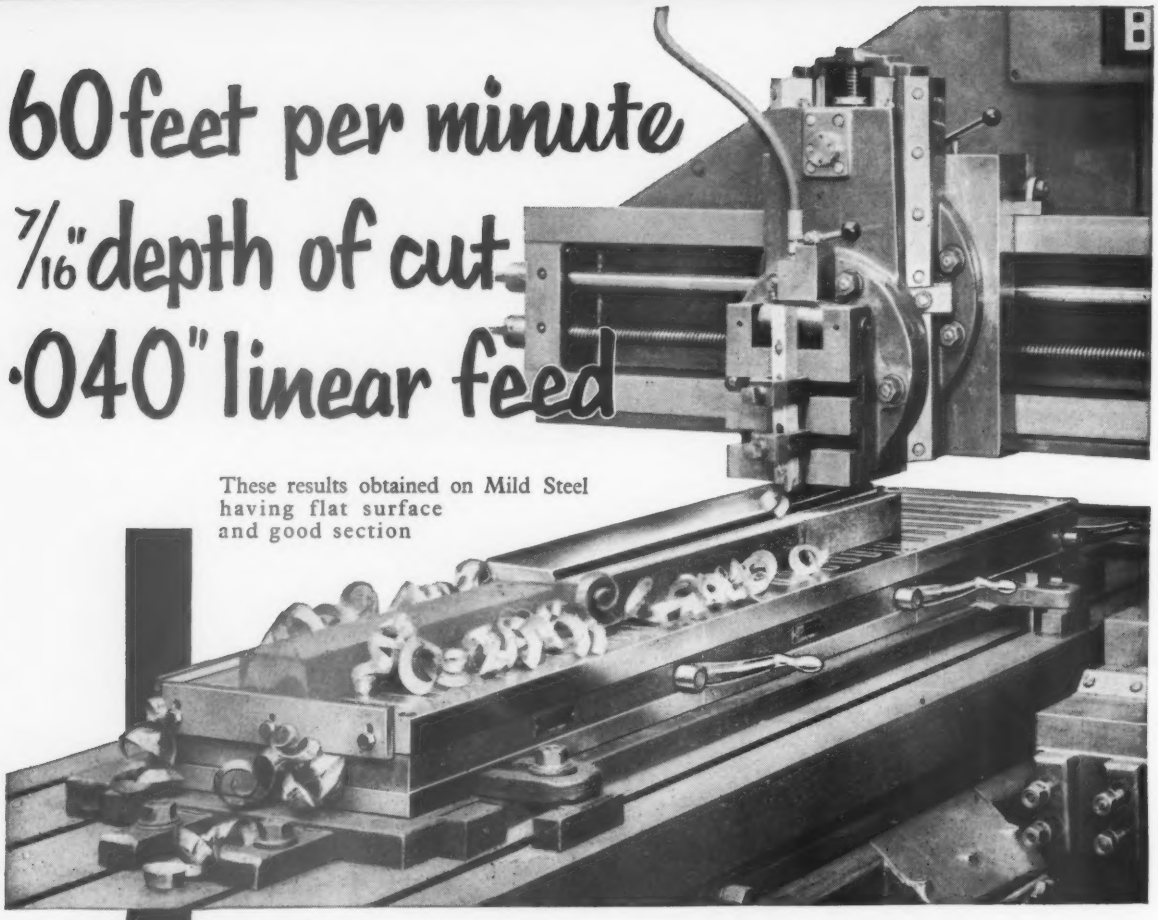
Circular Die Forgings, maximum weight 2,000 lbs.—Plain or punched slabs and special shaped forgings up to 40 inches diameter.

Taylor BROS. & CO. LTD.

TRAFFORD PARK STEELWORKS, MANCHESTER, 17

LONDON OFFICE: ST. ERMIN'S, CAXTON STREET, WESTMINSTER, S.W.1.

60 feet per minute
7/16" depth of cut
·040" linear feed



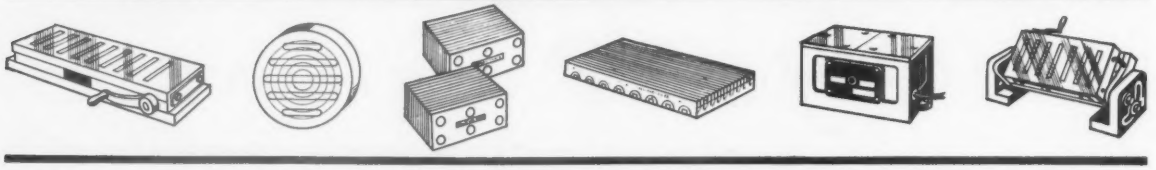
These results obtained on Mild Steel having flat surface and good section

magnetic chucking for speedier & more efficient work holding

Eclipse

the first name in magnetic tools

ask the experts for advice on YOUR holding problem

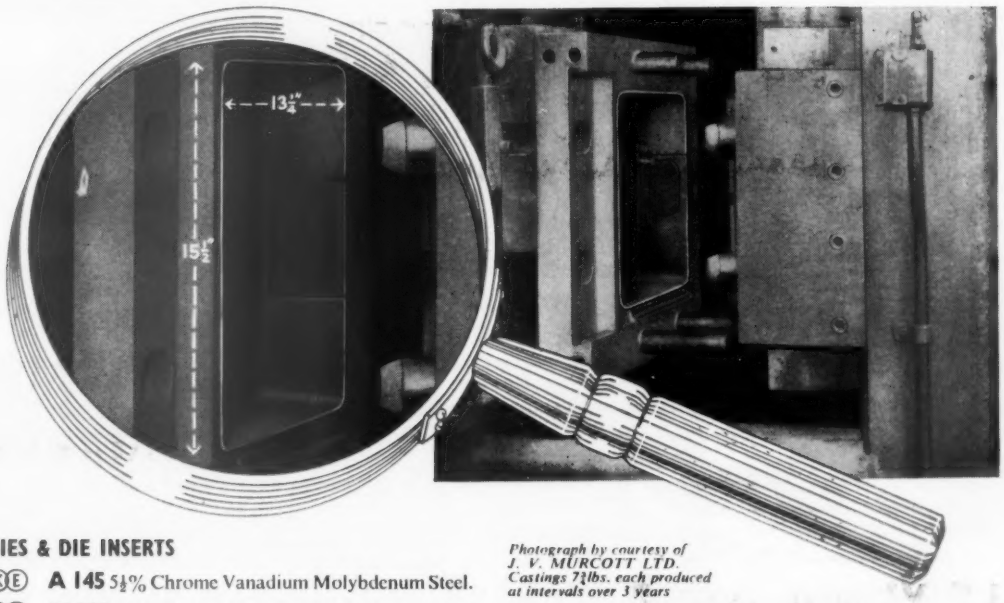


Made by James Neill & Co. (Sheffield) Limited—the originators of this equipment

Supplies through your usual "Eclipse" Distributor

PM 169

SPECIAL STEELS
for die casting dies



Photograph by courtesy of J. V. MURCOTT LTD. Castings 7¾lbs. each produced at intervals over 3 years

DIES & DIE INSERTS

(KE) **A 145** 5½% Chrome Vanadium Molybdenum Steel.

(KE) **X 369** 5½% Chrome Tungsten Molybdenum Steel.

(KE) **896** Medium Carbon Chrome Vanadium Steel.

Supplied in ultrasonically tested forged blocks and black bars of square, round and rectangular sections.

DIE CORES

(KE) LOCK **237** 18% Tungsten Vanadium High Speed Steel or the same quality of steel as that used for the die. Supplied centreless ground to precision limits, in lengths.

This booklet, giving greater detail, is available free on request.

EJECTOR PINS

(KE) **896** Medium Carbon Chrome Vanadium Steel and other types.

Supplied centreless ground and in the annealed condition, suitable for upsetting of the ends.

UNCOATED WELDING FILLER RODS

(KE) **A 145** 5½% Chrome Vanadium Molybdenum Steel.

(KE) **X 369** 5½% Chrome Tungsten Molybdenum Steel.

5/32" diameter material, in 3 feet lengths, available from stock.

Especially suitable for atomic welding under hydrogen.

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LONDON STOCK WAREHOUSE
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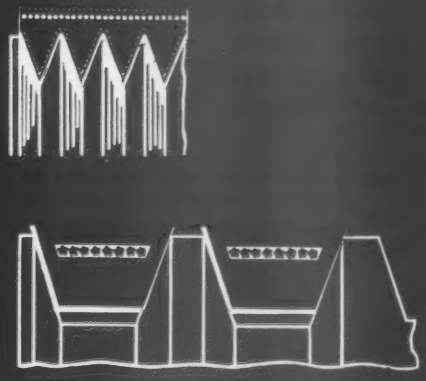
TELEPHONE: BAYswater 9131/2

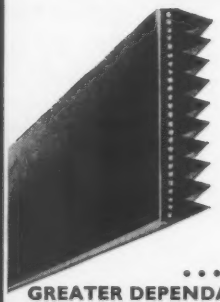
Comparative illustrations are TWO-THIRDS actual size

TURNERS [redacted] DRIVES

A NEW concept of [redacted]



'POLY-V' BELTS ELIMINATE 'MATCHING' PROBLEMS

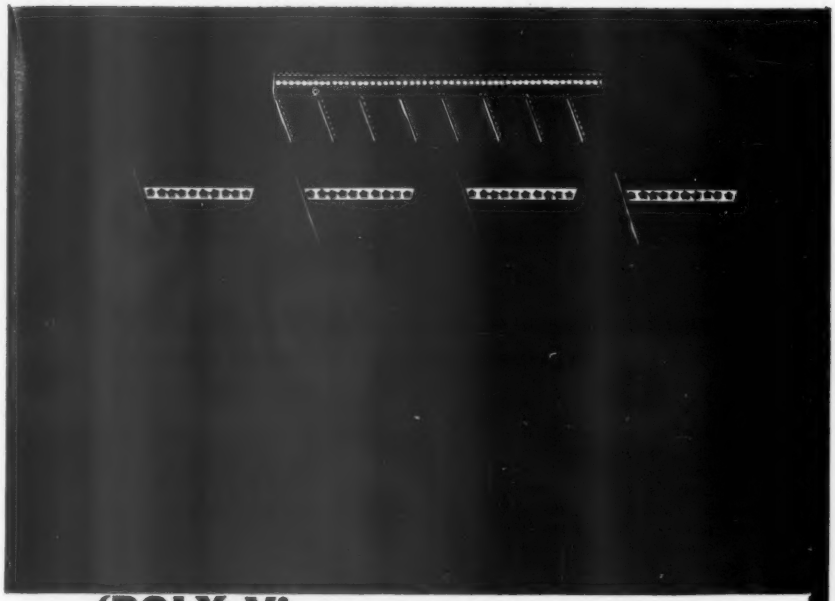


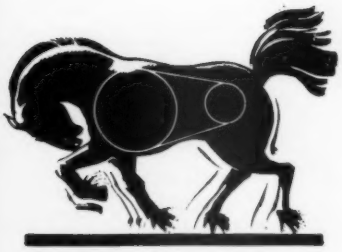
. . . this means
GREATER DEPENDABILITY
FREEDOM FROM VIBRATION DUE TO BELT SLAP
LONGER DRIVE LIFE
LESS MAINTENANCE TIME

The "Poly-V" Belt is a SINGLE UNIT across the full width of the pulley, not an assembly of several V-Belts which may vary in exact length and ride differently in the pulley grooves.

'POLY-V' DRIVE advantages . . .

1. "Poly-V" Belts transmit the same horse power as conventional V-belts on very much narrower pulleys. 2. The unique design of the "Poly-V" Drive reduces pulley widths to the minimum, resulting in maximum saving in space, pulley weight and costs. 3. In a "Poly-V" Drive installation smaller pulley diameters can be used for the same speed ratios. 4. Being single units, "Poly-V" Belts overcome matching problems associated with other multiple belt drives. 5. Constant pitch diameters at all loads are maintained on "Poly-V" Drives. 6. "Poly-V" Drives ensure minimum vibration and cooler running.





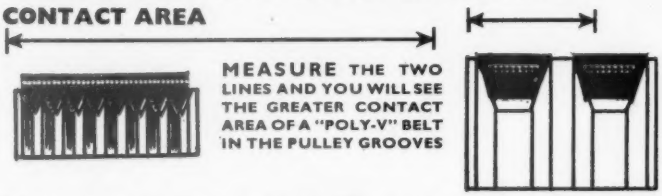
NO OTHER BELT delivers more power in the same space.

HERE is a revolutionary drive which consists of a single endless belt with longitudinal V-ribs and which drives pulleys grooved especially to mate precisely with them. The uniform pull of this single unit belt distributes drive load evenly over the full width of the pulley . . . resulting in a higher horse power capacity per inch of drive width than ever before possible.

COMBINING the simplicity flexibility and unitary strength of flat belts with the "V-Belt" advantages of high speed ratios, short centre distances and freedom from slip.

FOR FURTHER INFORMATION on "POLY-V" cross sections 'M' ($\frac{3}{8}$" wide) 'L' ($\frac{3}{16}$" wide) and 'J' ($\frac{3}{32}$" wide), sections write for publications BPV 1 and 7.

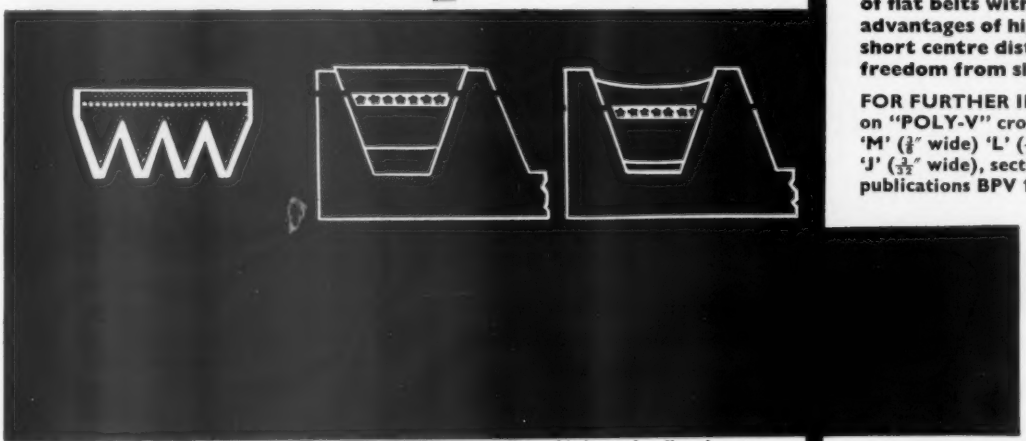
'POLY-V' BELTS TRANSMIT MORE POWER BECAUSE THEY HAVE DOUBLE THE DRIVING CONTACT AREA



MEASURE THE TWO LINES AND YOU WILL SEE THE GREATER CONTACT AREA OF A "POLY-V" BELT IN THE PULLEY GROOVES

Full contact area over the entire pulley driving surface gives uniform grip. Cooler running arises from the larger belt and pulley driving surfaces.

Reduced pressure per square inch between belts and pulleys leads to less driving face wear, and long service life. Uniform Grip. Cooler Running. Less Wear.



7. "Poly-V" Drives provide greater interchangeability of belts and pulleys because there are only two belt cross sections instead of five for multiple V-belt drives. 8. Longer lives of belts and pulleys are obtained on "Poly-V" Drives. 9. "Poly-V" Belts are heat and oil resistant. 10. "Poly-V" Belts, due to their small rib section, can be used in place of flat belts by cutting grooves in existing pulleys. "Poly-V" conversions on stepped pulleys are particularly successful. 11. Reverse idlers can be used without serious reduction in belt life. 12. On quarter turn drives, losses of power are negligible because of elimination of drag and chafing.

TURNER BROTHERS ASBESTOS CO., LTD.
SPOTLAND · ROCHDALE
ENGLAND
Telephone Rochdale 4221 (10 lines).
Telex 63-174.

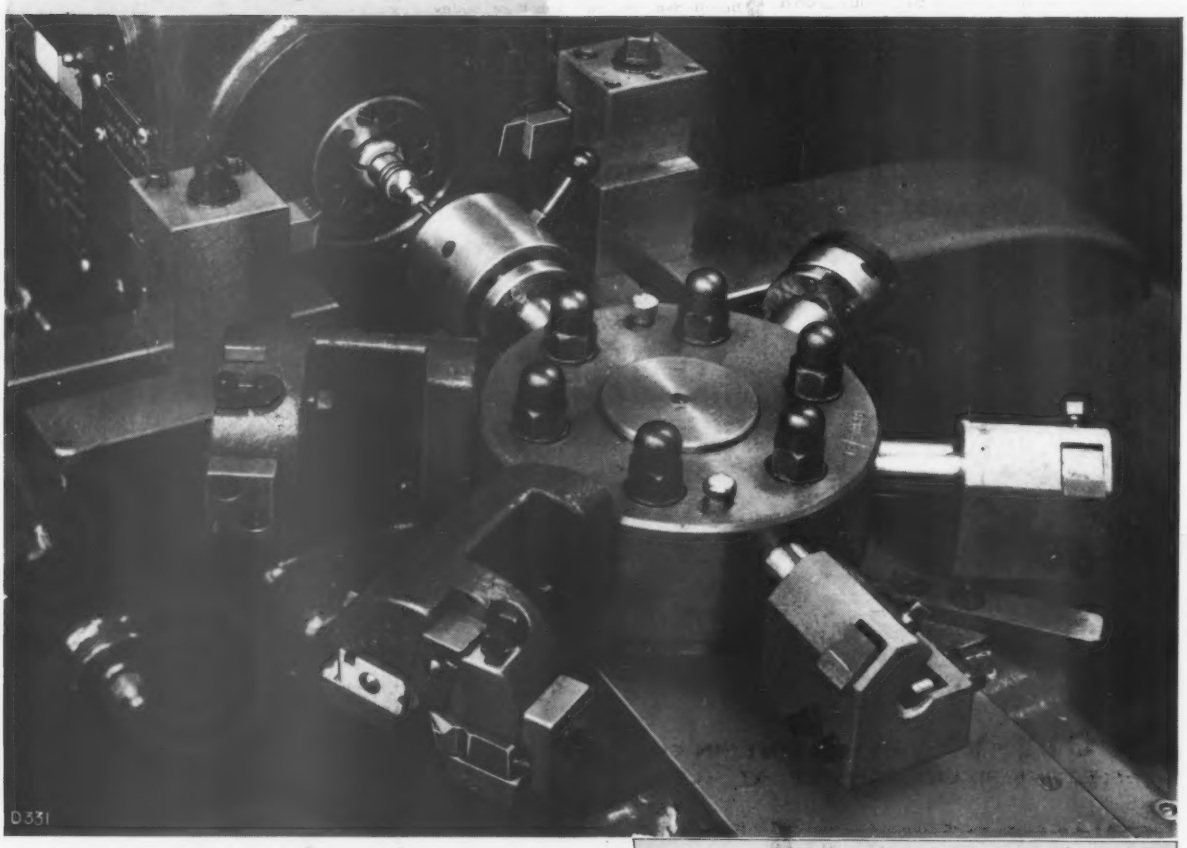
A MEMBER OF THE TURNER & NEWALL ORGANISATION

CW 6789

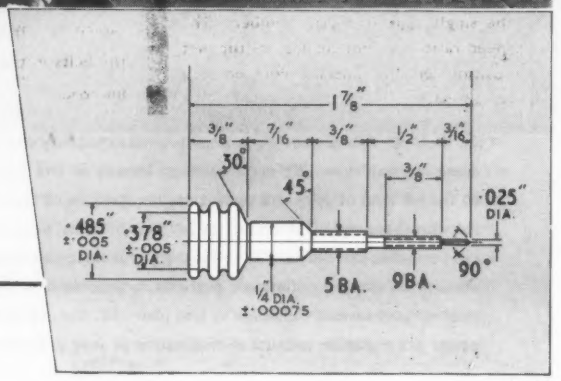
HERBERT

No. 0 Electro-pneumatic Capstan Lathe for high production bar work up to ½ in. diameter.

Now available for EARLY DELIVERY

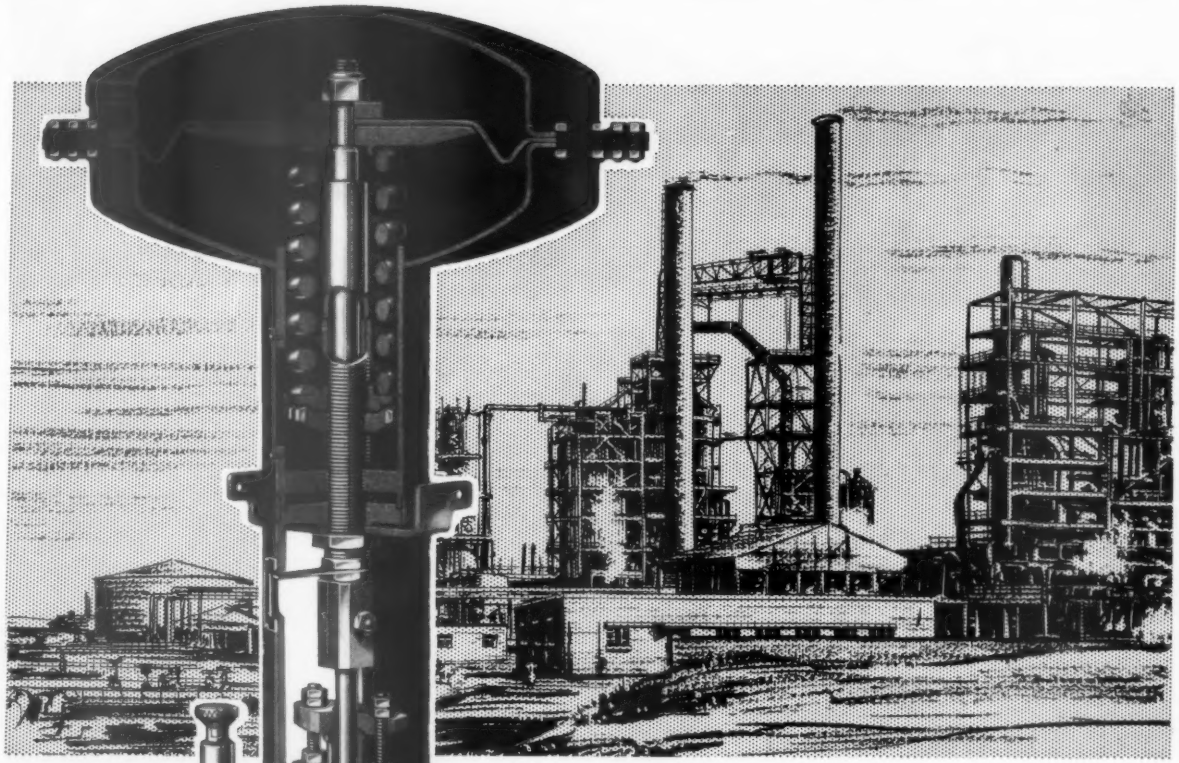


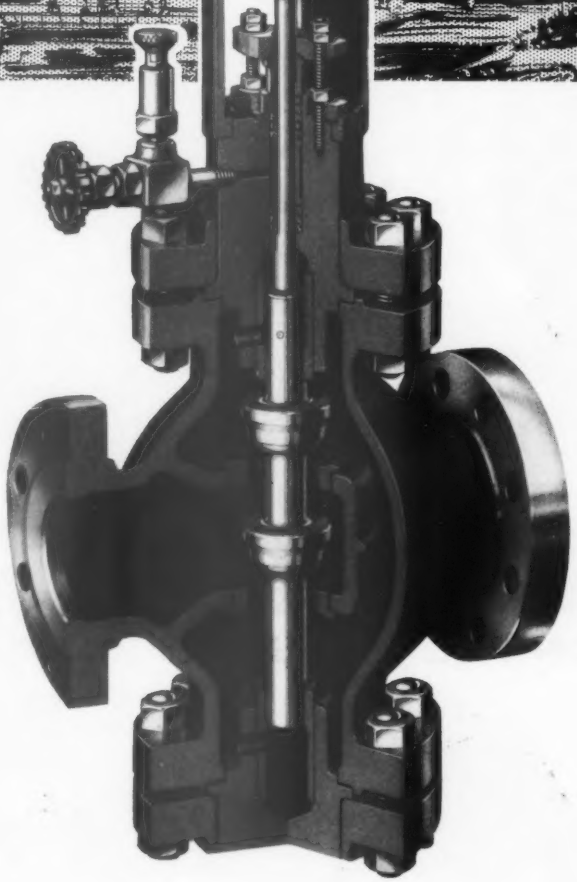
The component shown is machined from ½ in. diameter mild-steel bar in one operation on a Herbert No. 0 Capstan Lathe. Floor-to-floor time 90 seconds.



ALFRED HERBERT LTD., COVENTRY

AD.467





DIAPHRAGM CONTROL VALVES

Accurate, reliable, and economical, these Blakeborough types do full justice to the performance of the controlling instrument—hence their widespread use on modern automatic process control systems. An advanced and comprehensive range, well worth investigating.

BLAKEBOROUGH

J. BLAKEBOROUGH & SONS LTD · BRIGHOUSE · ENGLAND

ARCHDALE

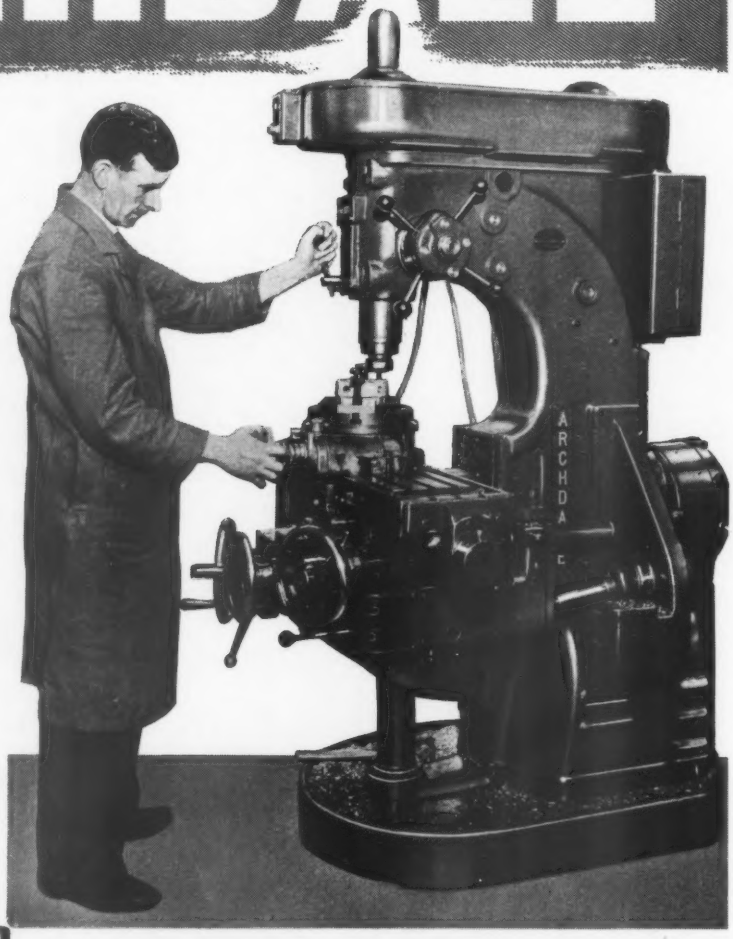
18″ VERTICAL MILLER

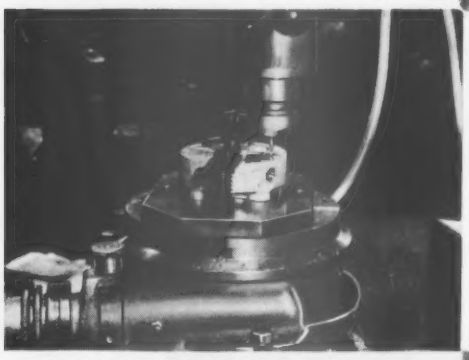
WITH FIXED OR SWIVELLING HEAD

With a range of eighteen spindle speeds from 80 to 2000 r.p.m. and four rates of automatic longitudinal table feed for each speed, these machines are capable of handling a very large range of work at fast rates. At Integral Ltd., Wolverhampton, several operations are carried out on aircraft hydraulic pump casings as shown.

Table working surface 10″ × 31″. *Maximum distance, spindle nose to table* 18″. *Available with fixed or swivelling head.*

Ask for details.

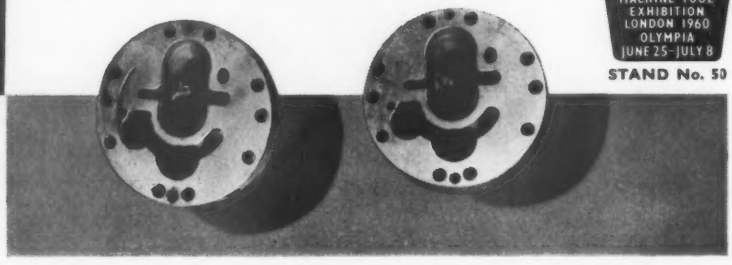




*** WIDE RANGE OF SPEEDS FOR MAXIMUM PRODUCTION ON ALL MATERIALS**

INTERNATIONAL MACHINE TOOL EXHIBITION LONDON 1960 OLYMPIA JUNE 25-JULY 8

STAND No. 50



JAMES ARCHDALE & CO. LTD.
LEDSAM STREET, BIRMINGHAM, 16.
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BLACKPOLE WORKS, WORCESTER
Telephone No. 27081 (6 lines)
A Member of the Staveley Coal & Iron Co. Ltd. Group
Sole Agents: ALFRED HERBERT LTD.
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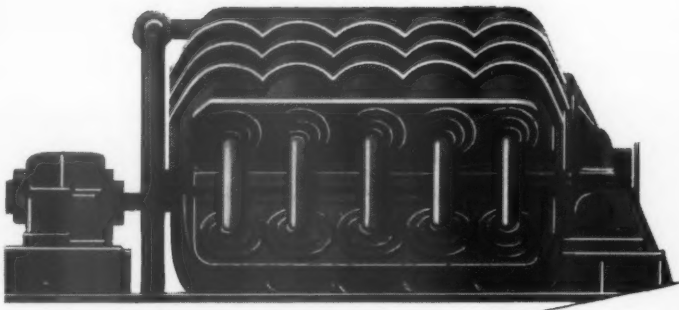
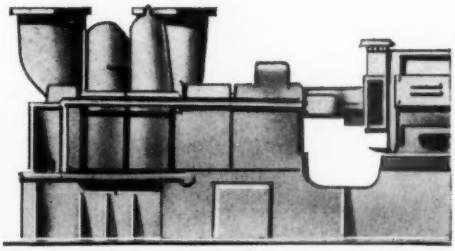
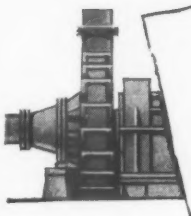
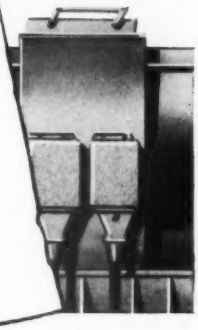
Centrifugal Compressing Plant

OF EVERY SIZE-OF EVERY TYPE



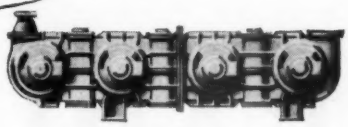


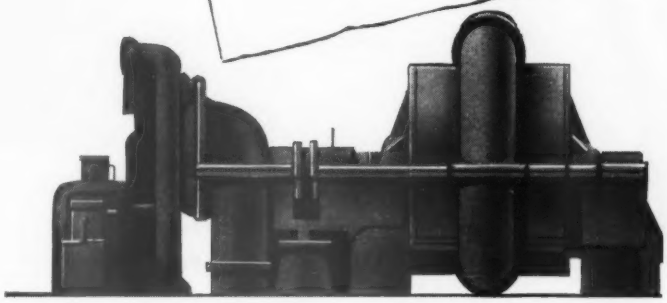




When calling for tenders

remember that in the manufacture of centrifugal compressing plant, A.E.I. has a background of nearly half-a-century's experience.
Competitive prices: early deliveries.
Publication G12131 will be sent on request.
For information on any compressing plant problem telephone **RUGBY 2121** Ext. 363





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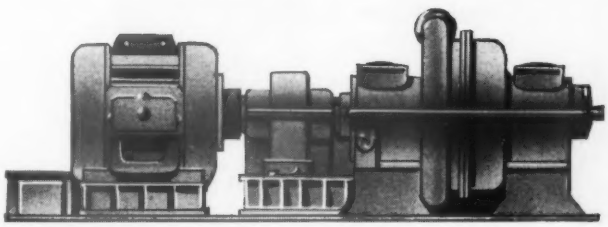
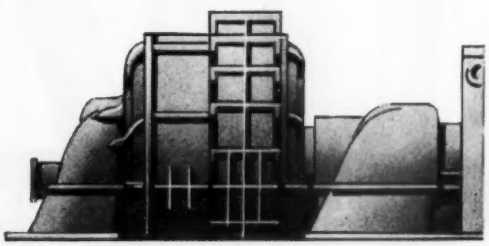
COMPRESSORS, BLOWERS
BOOSTERS, EXHAUSTERS
SUPERCHARGERS





ASSOCIATED ELECTRICAL INDUSTRIES LIMITED

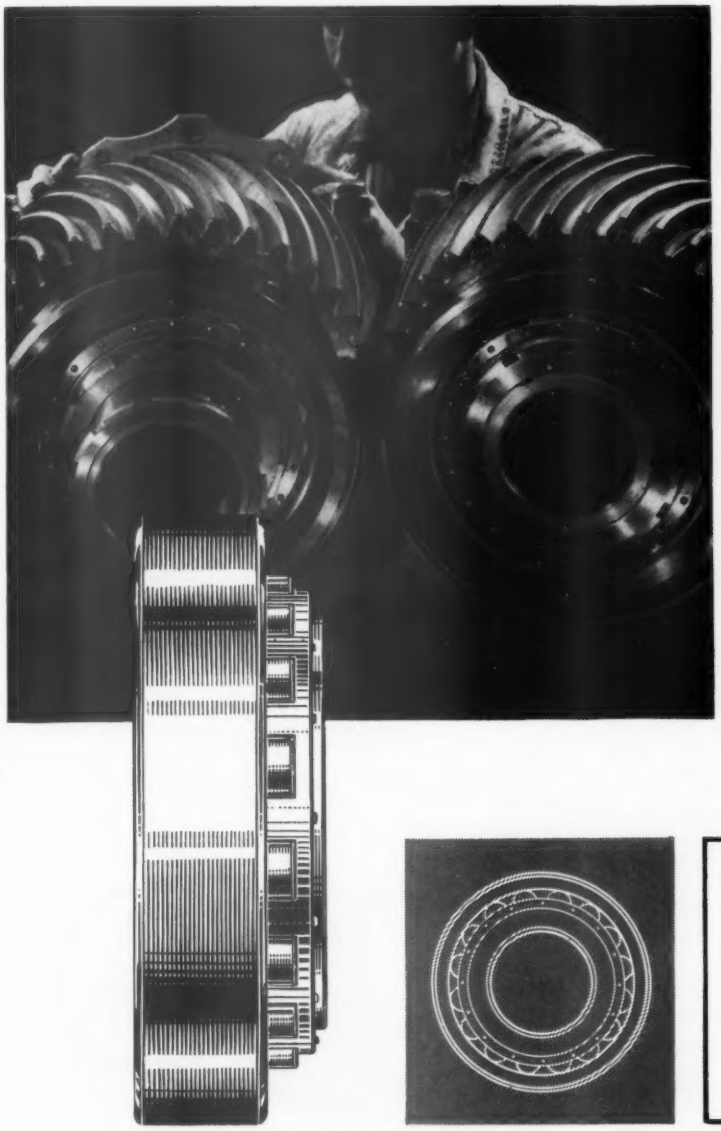
HEAVY PLANT DIVISION — **RUGBY AND MANCHESTER, ENGLAND**

A5338

HOFFMANN

right in the picture!

Bearings



* Napiers, in solving a problem in the gear-train of the Deltic engine, chose Hoffmann Bearings . . .

And when Napiers had another problem to solve, they again chose Hoffmann Bearings . . .

The problem was twofold: how to place the weight of the Deltic engines as far aft as possible in a fast patrol boat, and having done so, transmit full power indirectly to the propellers. Napiers solved the problem by producing the Vee drive gearbox shown in the illustration, an innovation with boats of this power classification (3,100 h.p.). Hoffmann Roller Bearings are clearly **RIGHT IN THE PICTURE!**

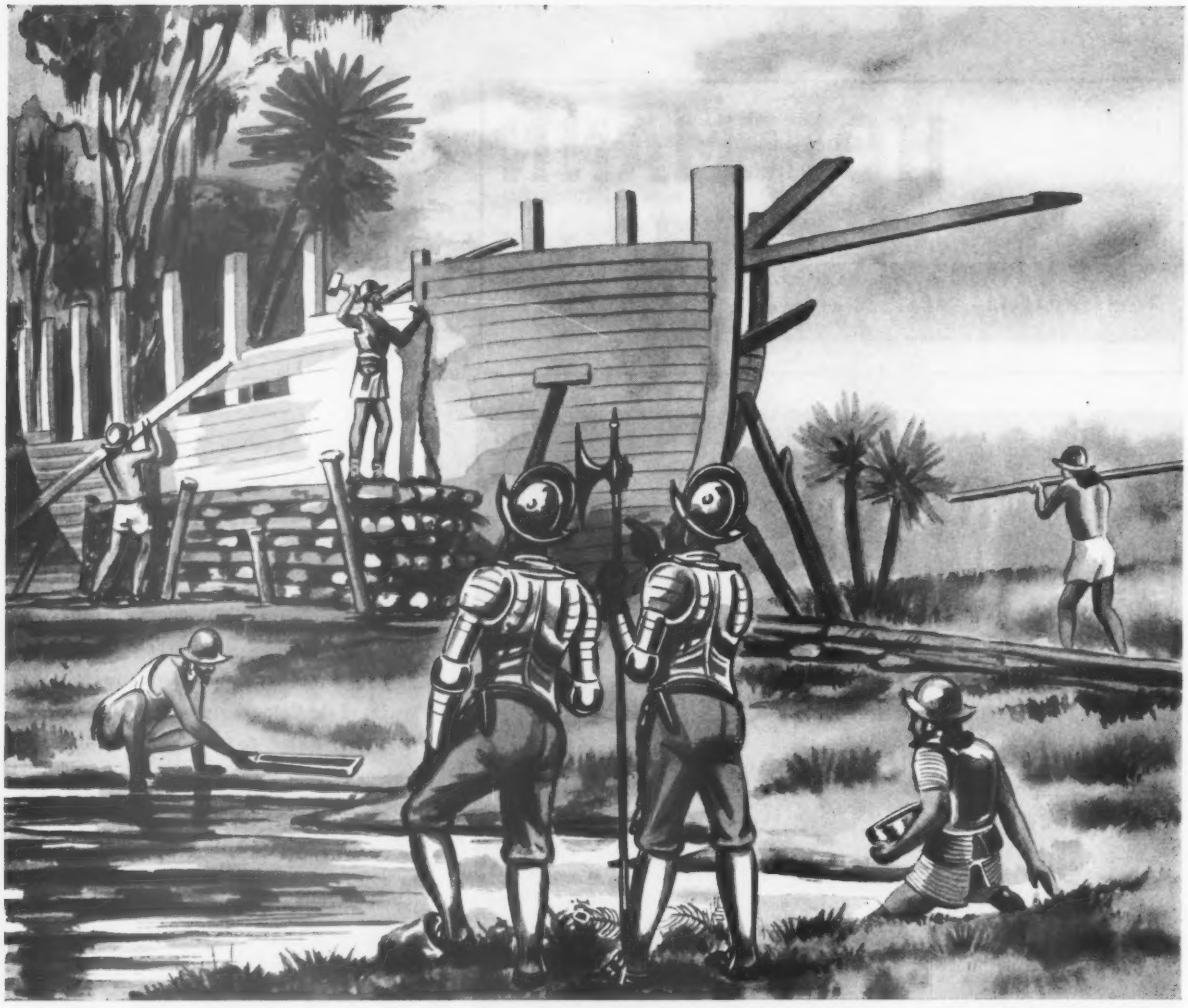
**And 50 years earlier . . .*

Extract—"Cycle and Motor Trades Review" Nov. 23rd, 1905. "The Hoffmann single row ball journal bearings have been adopted for the Napier Car, and all tests have proved satisfactory."

Specialists in Ball and Roller Bearing manufacture for nearly 60 years

HOFFMANN

THE HOFFMANN MANUFACTURING CO. LTD., CHELMSFORD, ESSEX



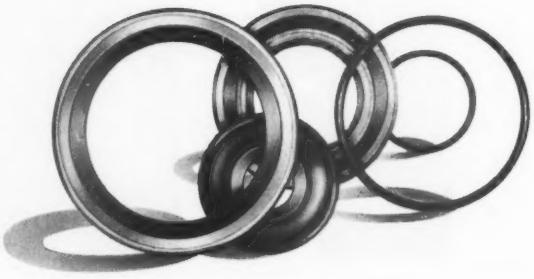
The Spaniards were the first to make use of oil. They found it in surface pools around the coast of North America and they discovered that, mixed with mud, it provided a wonderful caulking medium.

The discovery of oil provided a solution to the problem of lubrication but it also provided a problem for those who had to use it in machines. It proved a difficult prisoner — and still does, but it can be checked and we, at Super Oil Seals, have the answer to any oil sealing problem.

SEE US ON

STAND HH 27

MECHANICAL HANDLING EXHIBITION
EARLS COURT



SUPERFECT SUPER OIL SEALS & GASKETS LTD., FACTORY CENTRE, BIRMINGHAM 30.

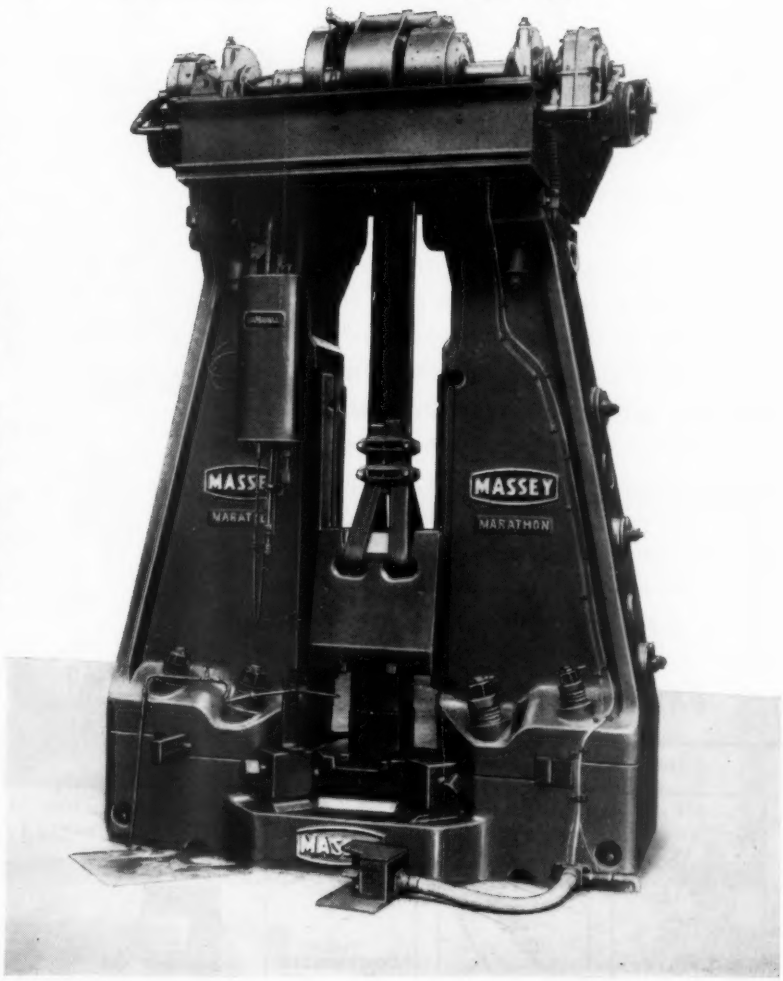
Telephone: KINGS NORTON 2041

MARATHON DROP HAMMERS

for high speed production of intricate forgings

Specially designed for high speed production of intricate forgings. Massey Marathon Drop Hammers have compressed air control for easier operation. Electrical drive ensures low upkeep costs and the design of the slides and standards makes accurate die alignment easy.

Important design features include fully automatic control for any length of blow and the lifter is insulated from shock for longer life. Available in sizes from 10 cwt. to 40 cwt.



20 cwt. Marathon Drop Hammer in our own forge.

STAND 26, GRAND HALL, INTERNATIONAL MACHINE TOOL EXHIBITION, OLYMPIA, JUNE 25th — JULY 8th, 1960

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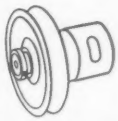

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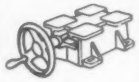

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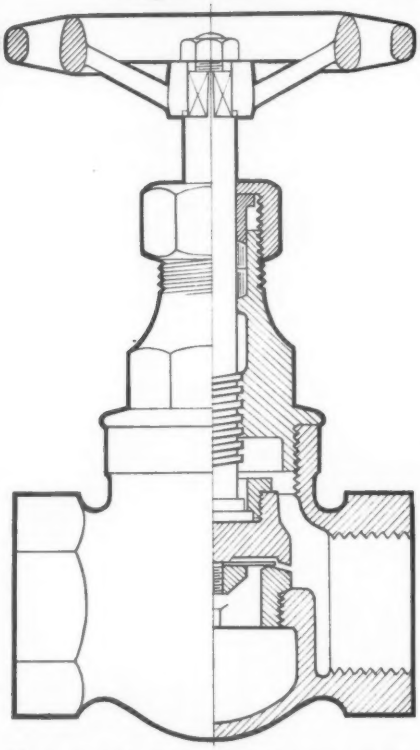
News from Hattersley



the Fig. 2016 'PRESEATOR' globe valve with the Flexible Titanium Disk*

This specially designed Hattersley valve incorporates a flexible pre-seating disk made of an I.C.I. titanium alloy which is exceptionally resistant to corrosion and erosion. As this seats before the main surfaces, pipe-scale is trapped and the main seating surfaces protected from the effects of wire drawing.

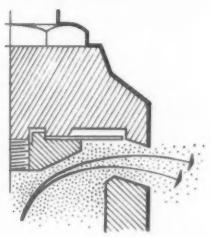
The broad-faced clack and its seat are of differing compositions of nickel alloy, giving differential surface hardness which prevents galling and seizure. There are many other fine features in this new design valve.

Suitable for steam at 200 lb. per sq. in. and 500° F.

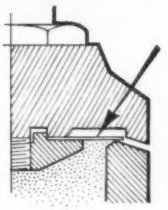
Please write for literature.

* *The Flexible Titanium Disk is protected by Patent No. 822147*

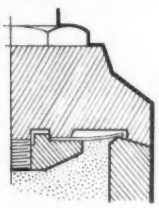
Over a period of years the outstanding merits of this Valve have been proved under the most arduous service conditions on many installations.



In open position free passage for flow directed across seating surfaces.



In 'Pre-shut' position flow and pipe scale held back by *Flexible Titanium Disk.*
Patent No. 822147



Valve fully closed. Seating surfaces have passed through wire-drawing zone under virtually 'no-flow' conditions.

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the name for good valves

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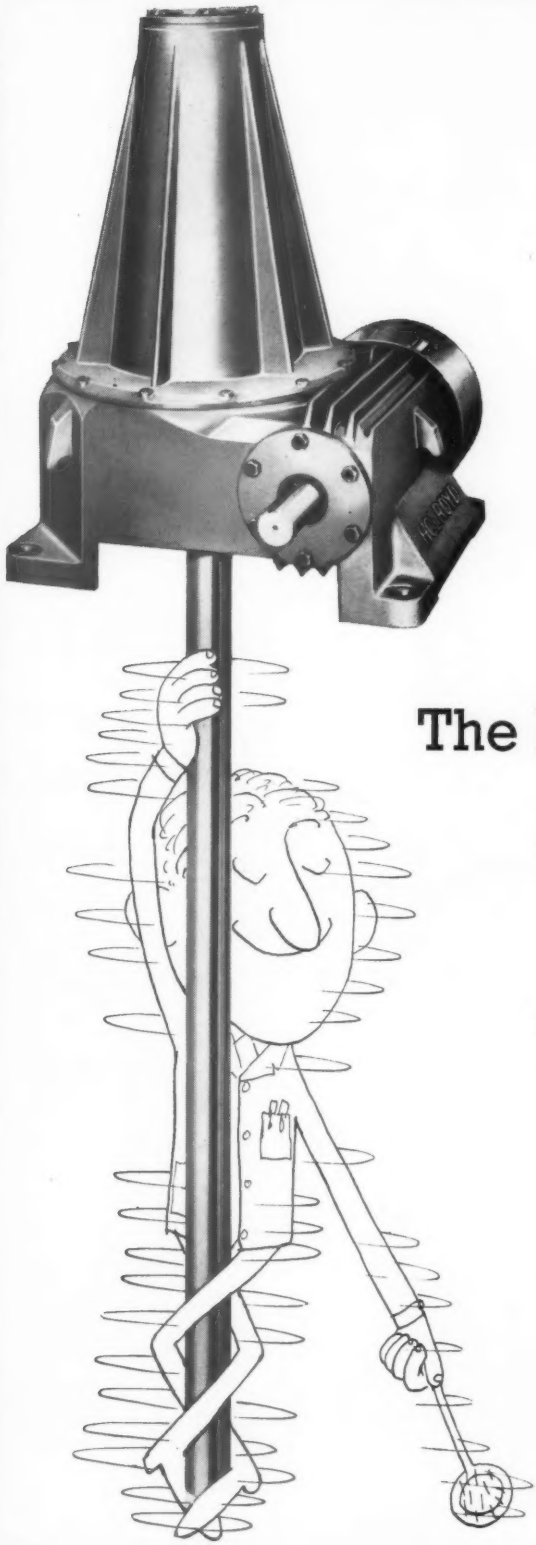
H.2



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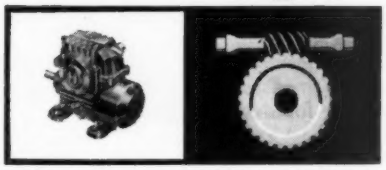
holds the shaft steady while you stir things up

Its full name is Agitator-type-Worm-Speed-Reducer-With-Extended-Top-Bearing and it is particularly useful in the chemical and allied industries for mixer and stirrer drives. The extension of the top bearing within the gear box gives the shaft extra rigidity for the mounting of propellers, mixing blades, or fans. The output shaft can be of any length and project either up or down. Please write for literature.

Holroyd



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CRCA3

Don't let George do it!

Not so long ago, machines which needed to be regulated to suit their output to changing conditions (pumps, for example) were attended by George.

From time to time George would emerge from some cosy corner to turn a valve or start or stop a machine, and all would be well—or comparatively well, because George, being human, tended not to move until drastic action was essential.

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Probably you are not concerned with pumps. Similar conditions apply, however, to most industries. Even when there must be a George to put the work into and out of the machine, adjustments to meet varying conditions (tension, thickness, pressure, temperature, etc.) are almost always best left to automatic devices controlling an N-S variable-speed a.c. motor or other suitable machine.

If you think you have some Georges in your plant, just tell us the nature of your business and we will send you some reading matter which may well prove useful. Write please to Laurence, Scott & Electromotors Ltd., Publicity Dept., 376 Strand, London, W.C.2., asking for details of automatic motor control systems.

'Asmag' control equipment (for example) will operate with an accuracy of a fraction of one per cent, before George has started to think.

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Tecalemit Ribbon Elements filter to maximum purity

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(Incorporating Tecalemit Ribbon Filter Elements)

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Tecalemit Breathers act as ventilators to provide a free flow of clean air to hydraulic fluid, fuel and oil reservoirs. They give positive protection from airborne contamination to tanks, pumps, valves, cylinder and other engine components.

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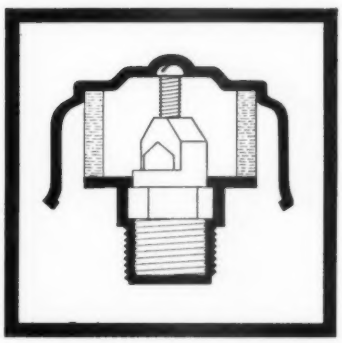
Tecalemit Breathers provide pure air cheaply and efficiently



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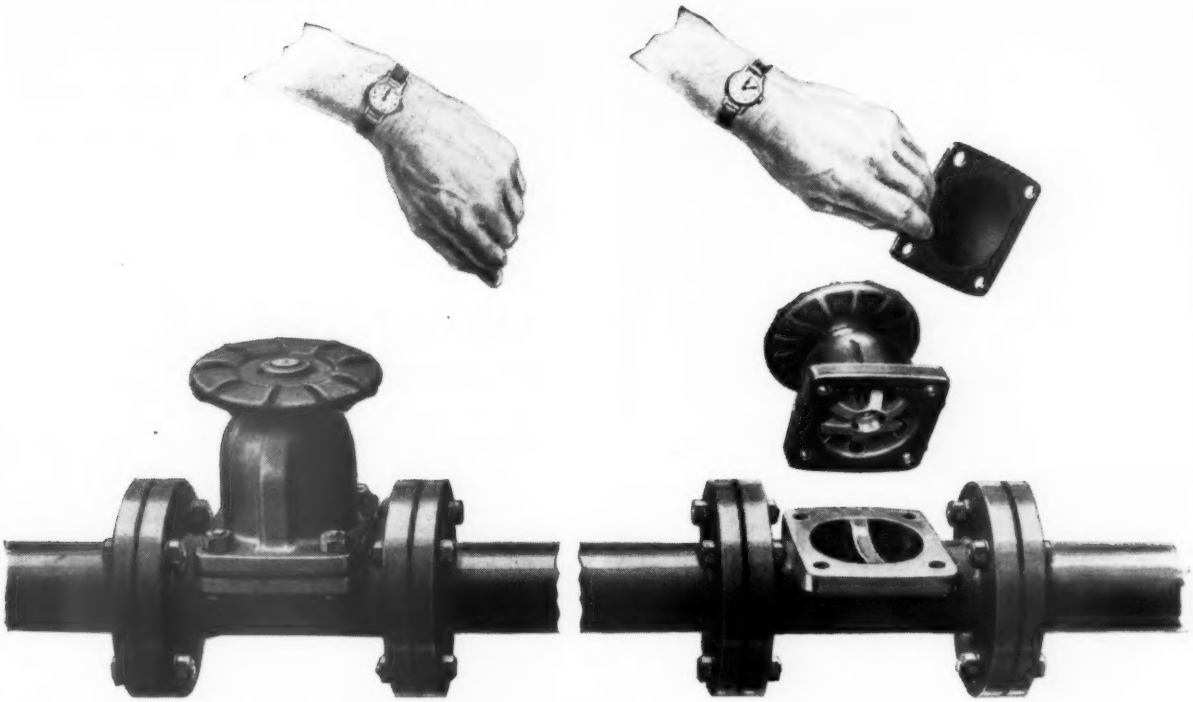

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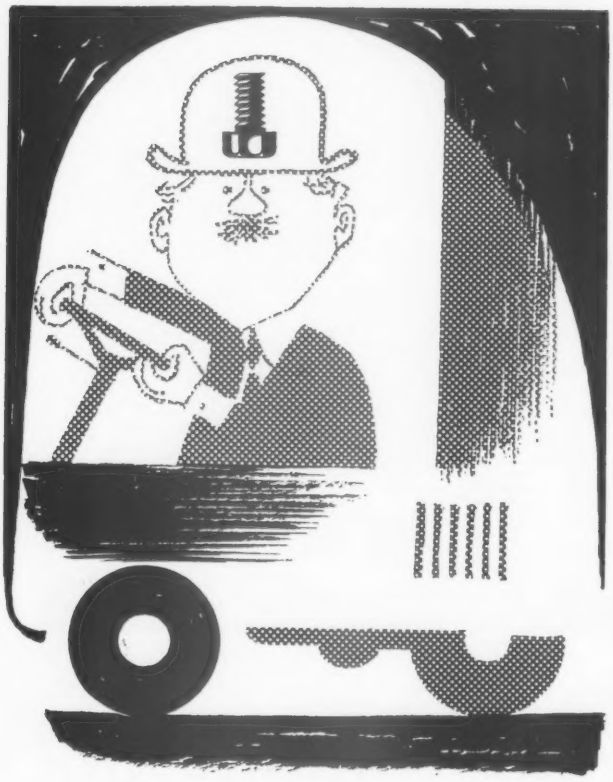

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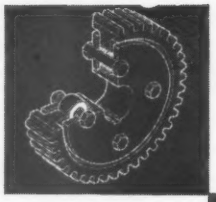
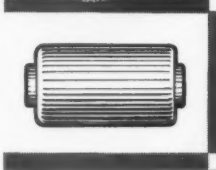


MORE AND MORE DAY BY DAY



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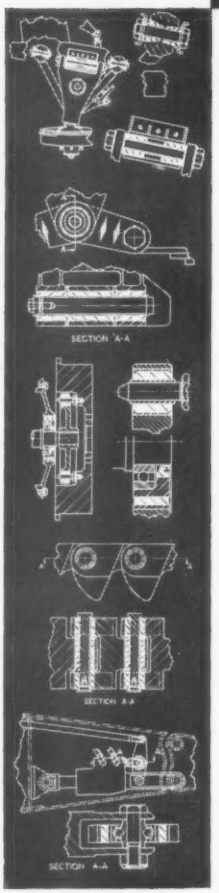

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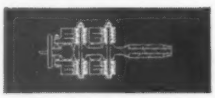

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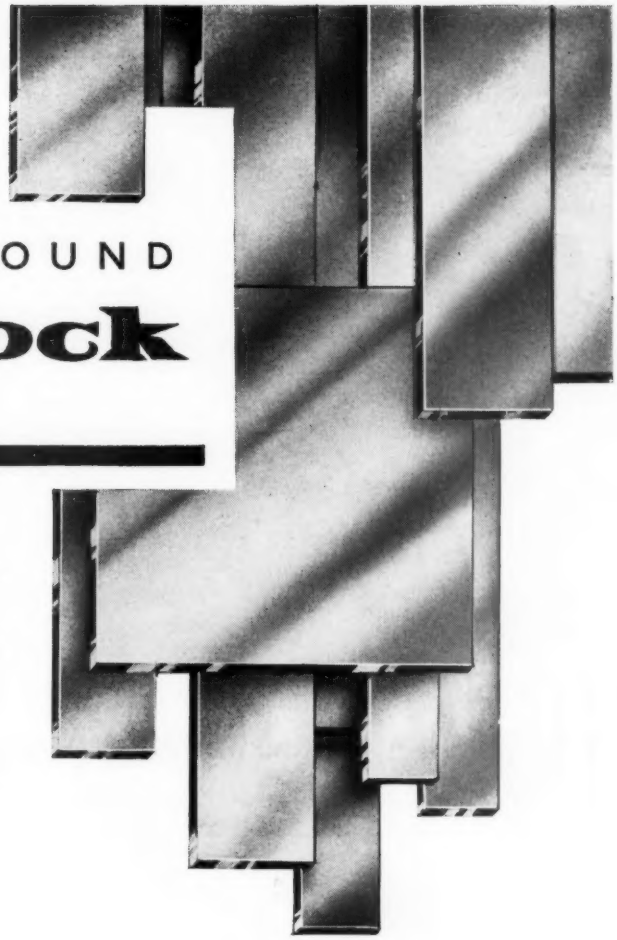

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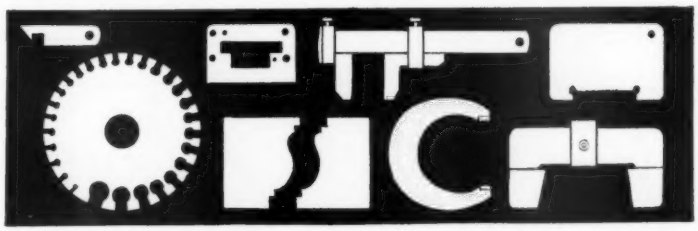

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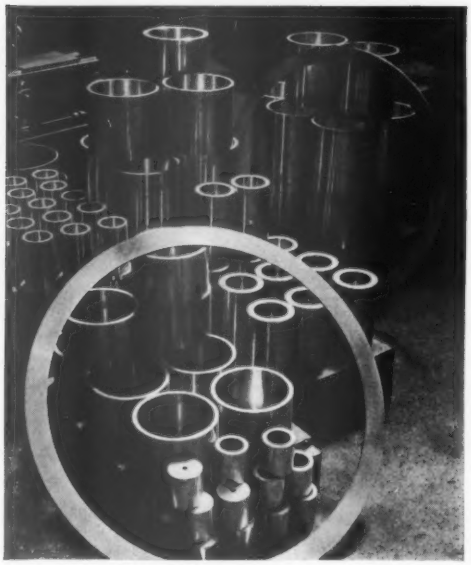

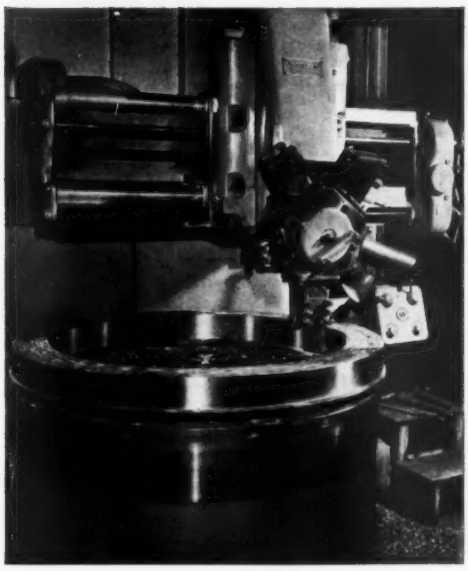

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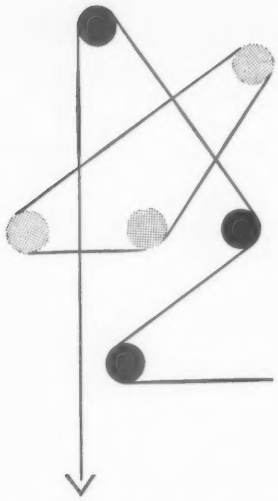

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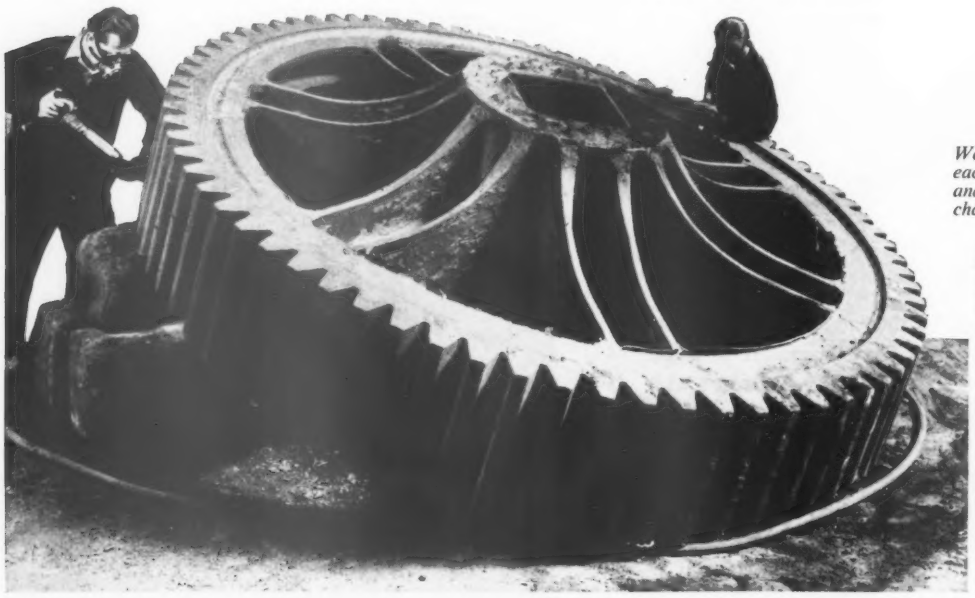

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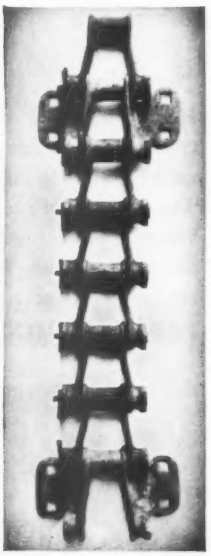

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Mechanical World

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Vol. 140 MAY, 1960 Number 3490

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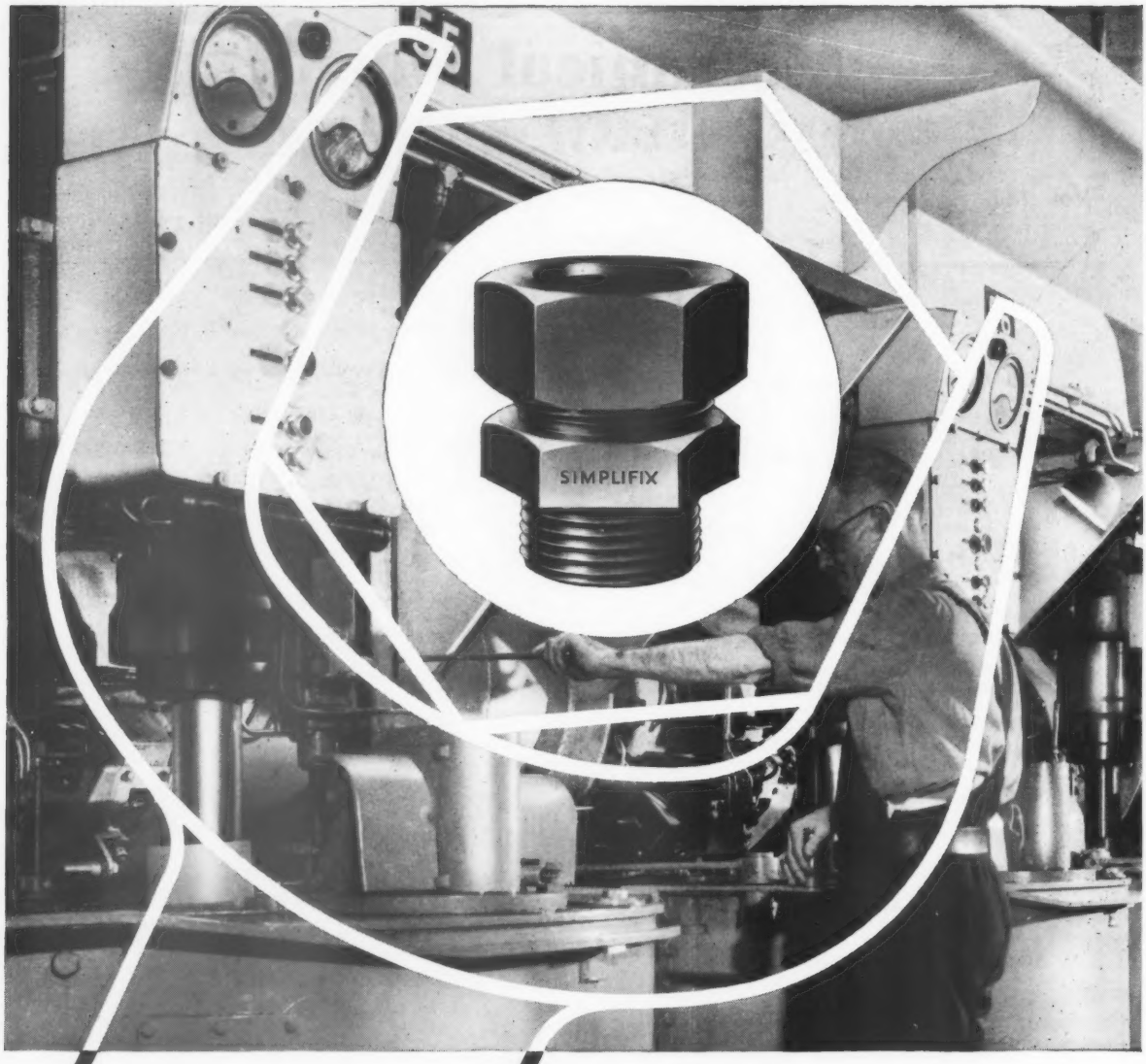
Contributions. The Editor invites original contributions on mechanical subjects. Broadly the aspects covered are the design, materials, manufacture, process, management and maintenance of engineering and industrial plant and machinery. Sketches should be in black ink if possible but the lettering may be left in pencil. Photographs are welcome and so are short notes of practical experience. Payment is made for exclusive contributions. Communications should be addressed: The Editor, MECHANICAL WORLD, 31 King Street West, Manchester 3.



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The illustration shows centrifugal machines at the Plaistow Wharf Sugar Refinery of Tate and Lyle Ltd., where large numbers of Simplifix couplings are used.

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Research Know-how

IT is undisputed in these days that research is essential for industrial development. There is plenty of evidence of the latter, and a survey made by the Department of Scientific and Industrial Research shows that expenditure on research by British manufacturing industry has gone up steeply in the last few years, from £190 million in 1955 to £300 million in 1958.

The way in which the survey was made is interesting because it throws some light on the cost of employing the research worker. In January, 1959, the Ministry of Labour and National Service made an estimate of the distribution of qualified scientists and engineers engaged on research and development. This was done for the Advisory Council on Scientific Policy. For their part, the Department of Scientific and Industrial Research carried out a special enquiry into the cost of employing a qualified worker, taking into account development expenditure and the use made of supporting staff. Leaving out the aircraft industry, which is unlike any other, the average is about £8000, which is 43% more than what it was in 1955. For some industries the figure is a good deal less than the average, and for others it is a good deal more. In the aircraft industry it is no less than £31,000.

The total amount of research expenditure was £300 million and of this no less than 95% was spent in industry's own establishments and only 5% in payment to research associations, universities and other research institutions. The biggest items were £100 million by the aircraft industry, £64 million by the electrical engineering industry and £43 million by the chemical industry, which leaves £93 million for all the rest.

This scale fits in with the industrial pattern, for examination of any manufacturing industry generally shows a few large concerns providing most of the investment, most of the unemployment and doing most of the work, and a very much larger number of smaller firms sharing the remainder. Closer inspection shows advantages on both sides. The fact of there being an economic unit for a particular product or activity settles the size, and whether the unit is an entity or a part of an industrial federation is usually no more than a matter of history or accident.

The clear evidence is that research is regarded as important all the way down the industrial scale. Irrespective of scale, just knowing how to deal with a problem scientifically is obviously worth a lot, and while at one end it amounts to a major operation, at the other it can often be done extemporaneously and with equal satisfaction. Knowing how matters.

LOG SHEET

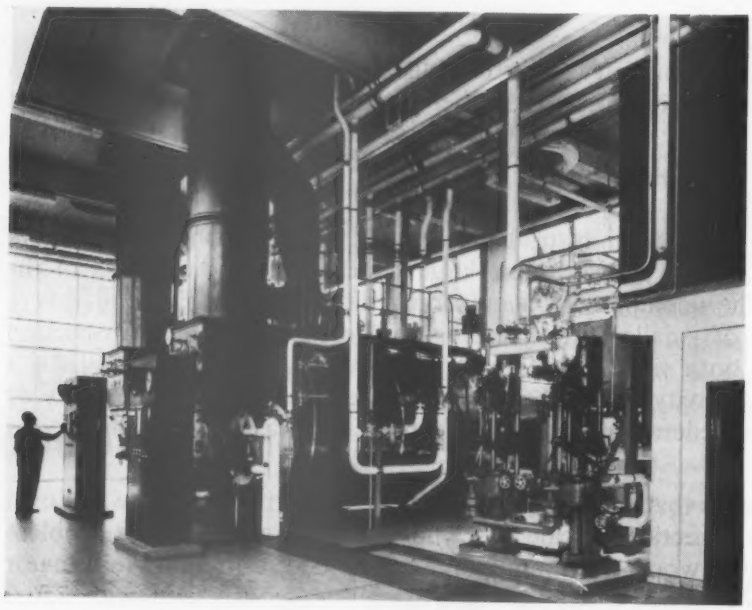
Boiler Showpiece

The new boiler plant at the Mobberley, Cheshire, factory of Ilford Limited contains two Davey Paxman Ultranomic boilers, each with a steam raising capacity of 10,000 lb per hr at working pressure of 80 psi. Fuel oil firing equipment embodying the rotary cup principle was manufactured by Hamworthy. Instrumentation and automatic control of the firing cycle enables one boilerman to attend to all duties required within the boiler house. The remainder of the plant comprises conventional types of pumps, heaters, induced draught fans, water treatment plant and condensate return systems.

The building, 92 ft × 45 ft × 25 ft high, is sited to take care of future expansion of engineering plant and to avoid any interference with other plans for factory development. A third boiler can be installed without additional building works. A reinforced concrete frame and curtain wall construction provides an impressive showcase for the boiler plant when viewed through the large areas of plate glass on the front and side elevations.

Inside the building there is an impression of generous headroom. The roof level which makes this useful working space possible was determined by the height of the two 22,000 gal oil storage tanks, neatly contained by a brick built enclosure integral with the building. This provides a feature acceptable to the fire office and makes it possible to avoid constant and often ineffective expenditure on thermal insulation. All the ancillary equipment is housed within the building, thus affording all weather protection during operation and maintenance. Externally maintenance is confined to the building itself.

Minor facilities include a small roller shuttered cubicle for the storage of glassware and chemicals used during routine feed water testing and a general purpose room where the boilerman can prepare meals taken on shift within observation of the boilers and main instrument panels. Lavatory accommodation includes a shower and changing room.



The new boiler plant at the Ilford Mobberley factory is spacious and well-lighted

Gear Making Teamwork

The ability rapidly to re-organize and enlarge its gear-cutting facilities, revise production schedules, and call upon the co-operation of associated companies, recently enabled the David Brown Jackson Division of Salford to complete, on exceptionally short delivery terms, an order for sets of unusually large gearing, which forms part of a sugar plant of British design destined for Russia.

The order, placed by Duncan Stewart & Co. Limited, Glasgow, covered the supply of eight sets of combined gear and path rings, with pinions. Gear dimensions ranged from 21 ft 2 in. to 23 ft 11½ in. dia, and the eight sets of path rings varied in size from 20 ft to 22 ft 9 in. The 24 items involved weighed in all 380 tons.

Production of gearing to these sizes in the short time allowed necessitated the provision of additional capacity and the opportunity was taken to extend the range of one of the large hobbing machines (of 16½ ft maximum capacity) to accommodate gears up to 32 ft dia, 10 ft face width, 70 ton in weight, and 4 in. circular pitch. As such, this machine is now the largest of its type in Britain and probably in the world.

This conversion was a major undertaking which, apart from the machine alterations, involved extending the machine shop itself to provide the additional floor space required. Moreover, whilst these modifications were being carried out, it was necessary to divert to the David Brown Gear Division at Huddersfield the gear-cutting work previously planned for the large capacity machines at the Salford factory. This in turn entailed a certain amount of smaller gear production being transferred from the Huddersfield factory to Salford. Time was another all-important factor, as the sugar plant order had to be completed within six months.

Alterations to the 16½ ft hobbing machine involved the provision of new foundations, a 20 ft dia table weighing 29 ton, a bed extension, and feed screw and drive shafts to hob, saddle and table.

Design, manufacture and installation were undertaken by David Brown Jackson Division engineers in collaboration with technicians from David Brown Machine Tool Division of Manchester, specialists in the design and building of large gear-cutting plant.

In producing the sets of large gearing for Russia single start hobs of 1 D.P. and 3½ in. C.P. were used. These were supplied by the David Brown Tool Division, Huddersfield, who also provided special hob

Hobbing is seen at left on a combined path and ring gear on a machine of which the capacity has been increased from 16½ ft to 32 ft dia by the David Brown Jackson Division of Salford. Finished segments are seen above. This particular gear measures 23 ft 11½ in. dia, 2 ft 8½ in. facewidth, and has 256 teeth of 3½ in. C.P. Each segment weighs 6 ton 18 cwt

sharpening facilities to enable continuous cutting to be maintained.

The path rings comprised four cast steel segments and in the provision of these the aid was sought and obtained of yet another associate, the David Brown Foundries Division of Penistone, near Sheffield. In addition to producing certain castings this company also made patterns for other suppliers of castings.

By spreading and at the same time co-ordinating the supply of castings in this way it was possible to complete the alterations to the hobbing machine by the time final machining had been carried out and the rings prepared for cutting.

Incidentally, some idea of the magnitude of the cutting operation may be gauged from the fact that 15½ ton of metal were removed from the eight path and ring gears alone.

Castrol House

Castrol House, the new headquarters of the Wakefield Castrol Group, the largest independent lubricating oil group in the world, is fifteen storeys high and covers a site of nearly one acre. The building is of reinforced concrete frame construction, the main architectural feature being a twelve-storey glass tower which is, by night, one of the new sights of London. This tower is floodlit internally through opaque green glass panels which surround the building beneath windows on each floor.

In addition to the normal office accommodation (the Group's headquarters staff numbers 800), Castrol House contains two restaurants, a showroom, several conference rooms, a cinema, an underground garage and, on the fourteenth floor, a residential suite incorporating five bedrooms mainly for the use of visiting executives from overseas. From this suite, there is access, via a spiral staircase, to an observation dome on the roof.

The building is notably modern in many respects; dominating the entrance hall is a mural (50 ft × 24 ft) designed and cast in aluminium by Geoffrey Clarke, A.R.C.A., who has made use of primitive symbols to develop his subject, the story of lubricating oil. For heating, the building is divided into zones, the temperature being automatically varied to suit the circumstances in each zone as governed by external climatic conditions. The cold cathode fluorescent lighting is controlled automatically by the intensity of daylight, and switches on when required without personal aid whenever daylight fades. The battery of electronic thirteen-passenger lifts travel at 500 fpm, the fifteenth floor being reached from ground level in twenty seconds. Internal distribution of documents is by means of a pneumatic postal system, the destination being selected by dialling a code number on a container which is placed in a chute and automatically delivered to the desired point in a matter of seconds. Two staff restaurants are situated on the ground floor, to serve the whole of the staff in the building. The basement contains a garage for over seventy cars, as well as fully equipped service and wash bays.

In the entrance hall of Castrol House there is a plaque commemorating the pioneer work of Octavia Hill who lived where Castrol House now stands. Most of her work was carried out within the borough of St. Marylebone. She was a champion of the open spaces movement and one of the three founders of the National Trust.

The Architects of Castrol House are Gollins, Melvin, Ward and Partners of 15 Manchester Square, W1, in association with Sir Hugh Casson and Neville Condor, and the main contractors were Sir Robert McAlpine & Sons Limited, of 80 Park Lane, W1. A photograph of the building appeared in our January issue, page 42.

High g Testing

The very wide use of instruments these days has raised the need for their being able to withstand high rates of acceleration, as when a heavy press goes into operation or when a rocket is fired. To test instruments for their suitability for withstanding such effects, E.M.I. Electronics Limited, of Hayes, Middlesex, have designed a vibrator which they are making to orders from China, Czechoslovakia, France and the U.S.A. as well as for government departments and manufacturing organizations in Britain. The vibrator is particularly suitable for testing at high *g*, valves, components, instruments, parts of structures and other test objects. During each stroke, the instrument undergoes an acceleration of over 100 times that due to gravity and is

E.M.I. vibrator for testing valves, components, etc. at high *g*

then decelerated at a similar rate. There are two strokes to each cycle, and at the maximum rate the instrument is subjected to 80,000 accelerations and decelerations each second. Ancillary equipment measures the stresses to which test objects are subjected and indicate resonance, which may lead to failure.

The Ubiquitous Circlip

Just how the circlip is ousting other methods of retention in bores and on shafts is illustrated by the great variety and immense volume of these fastening devices now turned out by Anderton Springs Limited, of Bingley, Yorkshire. They are made to British, European and American specifications and besides their popularity in new projects, they are being increasingly used in existing equipment because of the simplicity they offer in fitting compared with the inconvenience of so many older methods.

A wide range of tools for fitting circlips is available, including pliers, applicators for E-clips and a new high speed patented magazine-fed "Stack Feeda" for mass assembly.

For the project and prototype, engineer supplies of small quantities of any type, or size, of clip are available, normally from stock either as samples or on a minimum charge basis. In addition, the Anderton "Varipak", containing various types and sizes, is available and the clips are strongly packed in separate polythene compartments.

In the field of heat treatment there are new techniques and Anderton metallurgists have developed a new heat treatment for highly stressed components and the new "High Ductile" clips are now standard production.

Dip-coated Pump

What is thought to be the heaviest dip-coated article in the world was recently completed for the Esso Refinery, Fawley. It is the casing of a 30 in./24 in. horizontal D.S. pump supplying the main salt water delivery for cooling. Maximum capacity of the pump is 22,000 gpm.

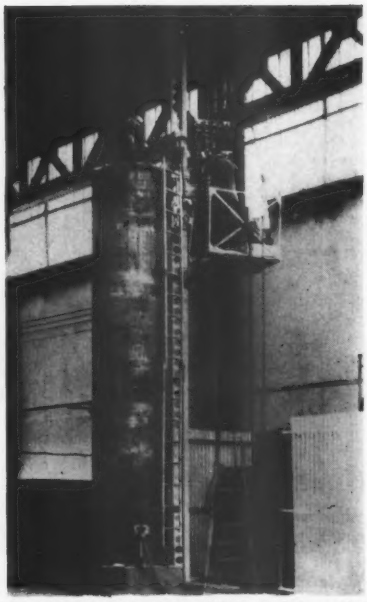
The pump casing consists of two parts weighing together 4½ tons. Each half was given an experimental anti-corrosive coating of PVC by dipping it into a trough of Geon PVC paste. The thickness of the PVC coating is $\frac{3}{16}$ in. The casing was formerly spray lined with neoprene rubber. By using the PVC dipping process in place of a multi-coat application of neoprene, the cost has been cut 50%. The pump

The heaviest article in the world to be given an anti-corrosive coating of PVC by the dipping process is here seen being lowered into a tank of Geon PVC paste. It is one half of a pump casing used in connexion with salt water coolant at Fawley Refinery

casing was dipped by Durable Plastics Limited, By-Pass, Guildford, Surrey, using a paste based on Geon PVC, a product of British Geon Limited.

Automatic Welding of Tanker Stern Tube

The accompanying photograph shows a large welding job in course of execution. It is the stern tube of a 73,000 ton tanker and is 17 ft long, 36 in. dia inside and has a wall thickness of 3¾ in. It was formed of two half shells which are seen in the



Two half shells, 3¾ in. thick and 36 in. dia being welded on a vertical machine using a single wire

picture being welded by the electro-slag process. The machine is a standard Vertomatic with column extension using a single wire, a current of 550/600 amp at 43/45 volt and laying 29·5 in. per hr single pass.

The Vertomatic machine was introduced into the U.K. last year by Rockweld Limited, of Croydon. Its advantages are particularly apparent with thick plate of 2 in. and over, which does not require preparation and therefore requires less weld metal, does not involve multiple passes, offers economy in flux powder and a high thermal efficiency.

Prefabricated Buildings

A two-storey administrative building has been added to the range of prefabricated designs made by F. & D. M. Hewitt Limited, Cranleigh, Surrey. It has a precast reinforced concrete framework, which is infilled with Cranley panels, window-frames, brickwork and so forth, according to requirements. The span may be as required up to 40 ft with the ordinary pitched roof, or up to 60 ft "superspan" with a roof pitch of 15°, which may have Stramit or built-up felt or other proprietary roof finish. The low-pitch roof may be used on any size span up to 40 ft.

Bay widths between uprights are usually of 15 ft, but may be less if

Administrative and stores block of the new factory being erected by Hewitt's of Cranleigh, Surrey, for Luff & Smith, Limited, Tool-Makers, Southampton. Total floor area is 9,000 sq ft. Behind can be seen the factory area of 15,000 sq ft, also erected in the "Cranley" system

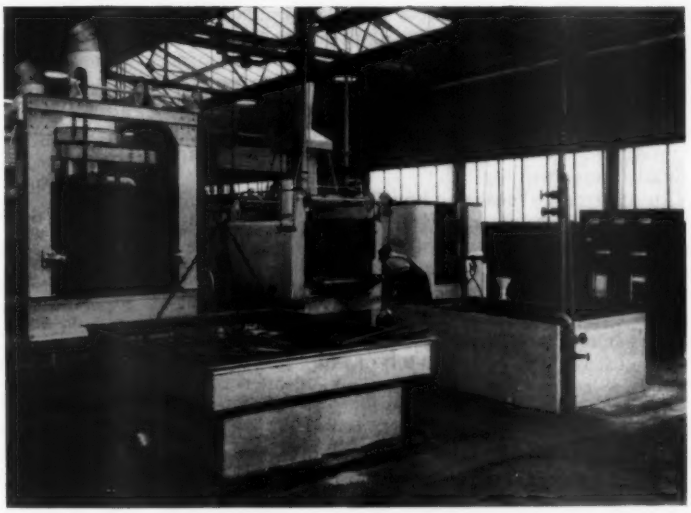
required. The bays may be infilled with Cranley Patent wall panels. These, having a vermiculite core, give excellent heat, sound and fire resistance with an attractive appearance of exposed aggregate externally and a smooth, hard surface internally —ready for painting if desired. Alternative finishes are of plaster internally and decorative finishes externally.

Geon PVC

Work will commence shortly on a £2 million extension to the British Geon plant at Barry, South Wales. Jointly owned by The Distillers Company Limited and the B. F. Goodrich Chemical Company of America, the plant has been operating for thirteen years and this is the eighth extension during that time.

Geon, the trade name for polyvinyl chloride (PVC) and other vinyl plastics raw materials, is derived from the Greek root "GE", meaning earth, to signify the raw materials used basically in its manufacture, coal, limestone, salt and oil. These are produced in the forms of resins, latices and compounds which are then processed by the vinyl plastics industry into secondary forms—plastics sheeting, leathercloth and coated fabrics, piping, sheet and cellular products in both rigid and flexible forms. From these secondary materials a wide variety of finished products are made: rainwear, curtaining, industrial protective clothing, PVC oilskins, furniture, car upholstery and fishing buoys; they are employed in the construction of chemical plant, for gas and water piping, and thermal insulation. In addition, PVC is used direct in making non-flammable coal conveyor belting, coated cable and wire, long-playing records, floorcovering and tiles.

British Geon Limited, Devonshire House, Piccadilly, London W1, provide an extensive technical service and offer advice on processing methods and equipment, supply data for users' market research and give full advice on compounding ingredients and techniques.



HEAT-TREATMENT SHOP.—This picture shows part of the West Midlands Gas Board's heat treatment centre in Adderley Street, Birmingham. In the photograph, small furnaces for general heat treatment may be seen. Part of the centre's work schedule was transferred to the Gas Council's stand at the Fuel Efficiency and Power for Industry Exhibition at Olympia where the stand was operating as a fully-working heat treatment shop

Leak Detector

The youngest of the industrial research associations in the Government Scheme—the Water Research Association—made its debut at the Physical Society Exhibition. It showed a new instrument for the detection of leaks in water mains.

The traditional method of detecting these leaks is by listening on the ground surface for noise caused by escaping water. Exceptional sensitivity and powers of discrimination are required for this work. The new instrument will help the Water Board inspector to identify noise sources which may be due to leaking water. It will then be for the inspector to discriminate by traditional methods the cause of noise.

A Rochelle salt pickup, matched to a low noise amplifier, operates the trigger circuit which causes a lamp to indicate when earth borne noise exceeds the predetermined background noise by three decibels.

Fancy Joints

The United Kingdom Atomic Energy Authority publishes an interesting monthly information bulletin called "Atom". In the March issue there is a description of one of the Authority's patents and there seems to be a suggestion that the Authority is desirous of exploiting the patent in a wider field. The subject concerns the joining of lengths of pipe of dissimilar materials so that differential expansion will not cause loosening of the joint. The joint, which is flanged and bolted, is an ordinary spigot and socket joint, with the one particularity that the plane of the joint face coincides with the plane of the back of the flange which contains the socket. Enquiries are invited to the Patents Exploitation Officer, U.K. Atomic Energy Authority, 11 Charles II Street, London SW1.

Electroformed Dies

In the production of a die for injection moulding even simple shapes and forms may account for several hundred man-hours, and capital costs may run excessively high for small components with relatively limited demand. Electroformed dies may, however, offer a solution and enable the full advantage of injection moulding as a production process to be realized. Long-lasting electroformed dies are made from nickel alloy direct from male patterns or masters

THE method of making conventional dies and moulds for plastic injection moulding in steels is invariably a lengthy and costly process. Nor is the method invariably satisfactory, calling as it does for a female mould copied from a suitable master with the final result very much dependent on the tool-maker's skill. Plastics copy faithfully small deviations in form or any surface defects—to say nothing of flow marks which can also arise—and considerable time is often involved in reworking, adapting and modifying the moulds to arrive at the near-perfection originally aimed at.

With an average 'cost per hour' of about 20 shillings for mould making, an injection moulded component is often outside the economics of a smaller manufacturer's budget and as a consequence he may have to fabricate the component at a much higher unit cost to avoid involving himself in high capital investments. On such a simple article as a tiny propeller for a toy boat, for example, the tool cost for a moulded nylon product may run into hundreds of pounds—for an article which subsequently costs a fraction of a penny per unit to produce. Some manufacturers can afford the initial outlay, others cannot think in terms of tens of thousands of unit productions. Yet the attraction of producing a better job remains, and for an ever increasing number of small components—both decorative and functional—injection moulded plastics offer a superior product.

The production of dies and moulds comparable in performance with tool steel moulds by the relatively inexpensive method of electro-forming, therefore, is of considerable interest. The mould or die in this case can be produced directly from a positive master, eliminating the costly process of tool-making. In this respect it has the same attraction as the now popular vacuum forming technique for moulding sheet plastic materials, which again dispenses with complicated and costly moulds. In this case, however, there is a difference. Electroformed moulds or dies do not represent an alternative process but a method of producing such tools for conventional injection moulding methods—thus taking full advantage of the lower cost of powdered plastic materials for injection moulding, as compared with the same plastic materials in sheet form.

Electroformed moulds have already been in use for some time in the toy industry for 'slush' moulding dolls heads and similar articles in polyvinyl plastics. The technique of 'plating' the mould over a suitable master allows a one-piece mould to be produced with undercuts, as called for, and entirely eliminating parting lines which inevitably give rise to flash—always a problem, particularly on long production runs, however good the initial moulds and set-up. The material generally used for electroforming is copper, built up to a reasonably substantial thickness. About the only limitation with this material, which is cheap and also forms heavy deposits readily in an electrolytic bath, is that it is subject to attacks by certain types of vinyl gels and the satisfactory life of the mould may be limited in such cases.

Electroformed copper and copper-alloy moulds have been produced for standard injection moulding machines using modified polystyrene, acetate and even nylon powders, with mixed success. Their attraction is their cheapness, but their useful life is limited. Nor is their performance always consistent.

A considerable improvement is realized by electroforming with a nickel-cobalt alloy which, if built to the required thickness and properly backed, should have a life at least equivalent to that of any good tool steel die. Resistance to wear should at least be as good as that of steel, and resistance to corrosion much better because of the superiority of the metal nickel in this respect.

Offering comparable performance with much reduced initial cost—because there is so much less labour charge involved—the electroformed die has a further specific advantage. Since it is formed directly over a male or positive master, intricate forms can be accommodated just as readily as simple ones. Electroforming has no preference in this respect so that a component specified as a moulding can be designed from the point of view of optimum form for the *component* and not with regard to the die from which it is to be made. This is distinct from a cost advantage—although, obviously, the more complicated the conventional die the more costly it would be—and in many cases makes it possible to forget die limitations which could adversly influence design requirements. Equally, more scope is given as regards the overall design of the die or mould, particularly, say, in the production of one-piece dies which are almost essential for optimum results when injection moulding nylon.

The process of electroforming starts—and virtually finishes—with the making of a master in any suitable material, metallic or non-metallic. It is even possible to electroform on plaster or wood (suitably sealed), sculpted originals or even 'mock-ups', suitably finished. A good surface finish is, however, essential, as the electroformed shell surface will faithfully duplicate every line and surface variation on the master whether such irregularities are intended or otherwise. But since the master is a positive shape or form it is relatively easy to work on.

Preparation prior to plating involves coating metallic masters with a suitable parting agent; or in the case of non-metallic masters coating with a suitable chemical surface which is conductive to electricity. The total thickness of surface coating in either case is usually only

of the order of 0.000005 in. and so is quite negligible as regards altering shape or detail on the master.

Plating then follows in an electrolytic bath. In the case of high-duty nickel-cobalt electroformed moulds, a shell thickness of about $\frac{1}{8}$ in. to $\frac{3}{16}$ in. is built up. The resulting shell is tough and ductile, free from residual internal stresses and with a hardness of about 44 Rockwell-C.

A further backing layer of copper is then electro-deposited on the nickel-cobalt shell, built up until the whole mould has the required form and volume from which it can be machined and ground to the desired shape to fit the steel bolster on the injection moulding machine. Fastening is made in the copper backing, through drilled or tapped holes or suitable fastening points machined into the copper backing. Whether or not the nickel-cobalt shell surface also requires final working depends largely on the surface finish of the original master. If necessary it can be polished or even reworked, but it is obviously more costly to work on the shell with its female shape fabricated in a hard metal than on the original. From this stage on, in fact, the electroformed die or mould becomes just another mould waiting for the machine—but produced at a fraction of the cost and time.

In service, the durability of the electroformed nickel-cobalt mould can show to advantage, maintaining a high finish and good match to minimize flash probably longer than any steel mould—assuming a similar initial set-up. Nor is the use of this type of mould limited to injection moulding with thermoplastic materials. Electroformed nickel-cobalt dies have been employed successfully for compression moulding such materials as acrylic plastics, thermosetting plastics and rubber compounds. They have also been tried for die-casting moulds for zinc-base alloys (tempering the shell to enhance its resistance to thermal shock), transfer moulding and blow moulding in plastics and glass. All of these applications outside injection moulding are, however, relatively recent and not yet fully established.

Undoubtedly the main scope for electroformed moulds is for low cost tooling for injection moulding in the common thermoplastics, particularly where the shape is intricate or fine detail has to be reproduced faithfully and cleanly. It has also proved a particularly suitable material for forming dies for nylon injection moulding of stressed components like gears, race cages, etc., where the low viscosity of nylon often gives trouble in arriving at a satisfactory production set-up with conventional dies machined from solid stock.

Distillery Handling System

Electrical weighing, central control and pneumatic lift

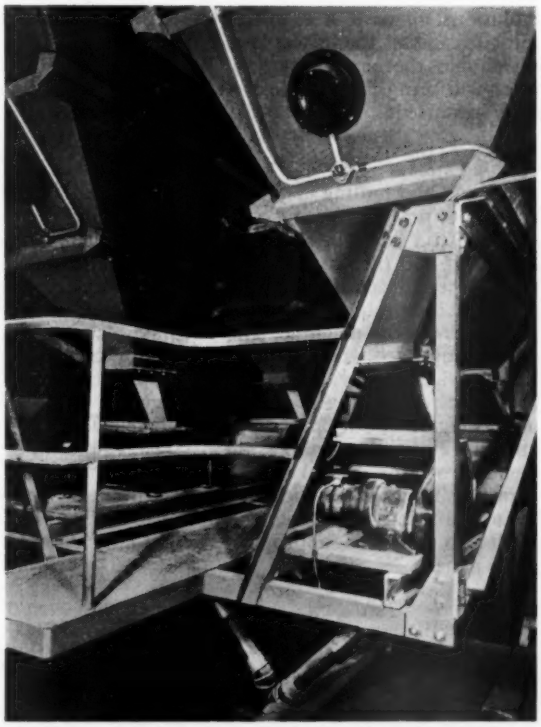
A WEIGHING, distribution and control system which is the first of its type to be installed in Scotland forms part of recent extensions to the Ben Nevis Distillery. Thomas Robinson & Son Limited, Rochdale, were main contractors for the complete project, including the modern steel-framed building in which the new plant is housed.

Although tailor-made to the precise requirements of the distillery, the control system follows the general pattern devised by Robinson's electrical engineers for other recent installations. It includes a central control panel supplied by Elliott Brothers (London) Limited, who also supplied the load cells on which the electrical weighing system is based. The system is sequence controlled to ensure the regular choke-free flow of materials throughout the plant, and is designed to reduce the consequences of human error on the part of the operators.

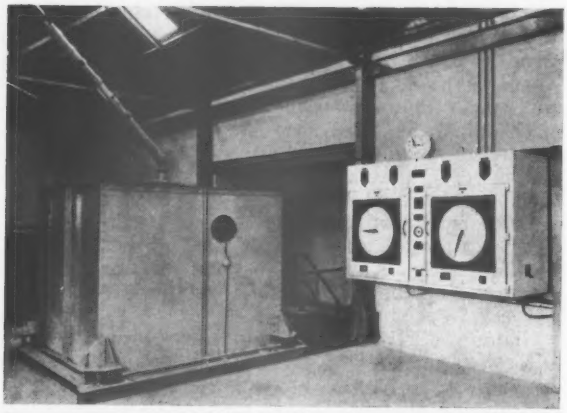
Stock enters the plant via a platform level hopper, which feeds the four 15-ton sheet steel intake bins by means of worms and elevators. Control of intake is provided by a separate panel convenient to the intake point. High and low level indicators are fitted to the bins, the high level indicator being used to operate an audible warning device on the intake panel which can only be switched off at the panel when the operator arrives to change over to another bin. The low level indicators actuate lights on the central control panel which indicate the availability of stock in any of the bins.

Cleaning and milling

From the intake bins stock is conveyed via Robinson type BQm feeders, worms and elevators to the Robinson pre-cleaner type PDm. A selector switch on the central panel enables the operator to select any of the four bins, and by depressing a button on the panel he can then start the appropriate feeder and the worms and elevators to deliver stock to the pre-cleaner.



Robinson type BQm feeders fitted to the intake bins are controlled from the control panel. The diaphragm type indicators fitted to the bins actuate lights on the panel which show the availability of stock.



The central control panel at Ben Nevis distillery with the 180-bushel weigh bin on the left. Note the bin level indicator fitted to the side of the bin, and the load cells mounted at each corner

Five separations are made by the Robinson machine, which is fully exhausted by a built-in fan to a separate cyclone, the light dust being bagged off with the tailings at a point convenient to an off-loading platform on the floor below. The cleaner is also being used to clean grain for planting on the Great Glen estate.

From the cleaner stock falls by gravity, via a magnetic separator, to the hammer mill which cracks it to a size which gives a faster rate of water absorption for mashing and cooking. To enable the grinder to work with maximum efficiency on the varying amounts and types of stock a variable speed motor has been fitted to drive this machine. The speed is controlled from the central panel where a tachometer indicates the number of revolutions. Since it is essential for the variable speed motor to start at the lowest speed, it has been arranged that should the emergency stop be operated the pilot motor will bring the brush gear to zero before the flow can be restarted.

Weighing system

Cleaning and milling of the stock having been accomplished it is now delivered from the mill to either of two weigh bins on the floor above. Delivery is by pneumatic suction lift and then by elevator, the pneumatic suction through the mill serving to clean the screen more rapidly and thus tending to increase the capacity which can be expected from the machine. The pneumatic suction fan and the motorized wheel valve at the foot of the cyclone, together with the elevator, are started by a single button on the central panel. A 180-bushel weigh bin and a 60-bushel weigh bin, both mounted on load cells for remote indication electrical weighing, are installed. Choice of bin is made from the central panel where a selector switch operates a motorized dividing valve at the head of the elevator carrying stock from the mill. Movement of the switch also selects the appropriate weight indication dial on the panel.

Process control

The 180-bushel weigh bin feeds stock by gravity to the cookers. There are two steam pressure cookers, each having a capacity of 90 bushels, and the procedure is to fill one while the other is cooking. The resultant gluten from both cookers is delivered by a common pump to a mashing machine and thence to the mash tun. Stock

The motorized flap valve which diverts stock from the grinder to either of the two weigh bins mounted on load cells

from the 60-bushel bin is gravity fed direct to the mashing machine. A high level indicator on each of the weigh bins cuts out the motor of the intake bin feeder in operation at the time, and operates an indicator light on the control panel to show that milling is completed and that the cooking and mashing process can commence.

Two 5000 gal insulated hot liquor tanks heated from the plant's main boiler, supply hot water to the sparger fitted to the mash tun. They also supply hot water for washing down.

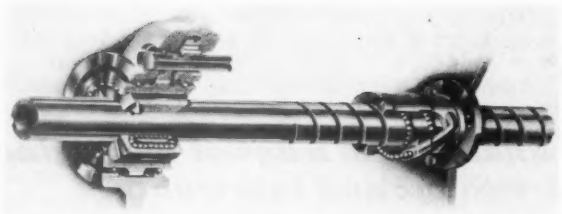
The wort is drawn off from the mash tun through a wort regulator to the 2000 gal capacity underback situated below. It then travels via a plate-type cooler to the washbacks for fermentation. Eight washbacks have been provided, each with a capacity of 5000 gal. They are of concrete construction, the interior surfaces being sprayed with Neoprene synthetic rubber.

The mash tun, which has a capacity of 30 quarters, has rake arms fitted to the rummaging gear which divert the draff to two outlets in the base. The draff then falls by gravity to a conveyor which feeds at lorry height in a bay adjacent to the intake bay. A proportion of the draff is fed to cattle on the Great Glen cattle ranch.

3-D T.V. for Remote Control

A three-dimensional television system developed by Pye Limited, Cambridge, is for remote observation, and the control and manipulation of materials and processes. It can be attached to any existing closed-circuit TV installation.

A Pye master slave manipulator can be used in conjunction with the new 3-D equipment for remote handling. The operator, having stereoscopic vision, can pick up any article by remote control. The three-dimensional effect is obtained by a mirror beam splitting system at the camera position and an arrangement of mirrors at the monitor end.



An application in which both a ball screw and a ball spline are used. Rotation of the gears (left) causes the shaft to rotate; the fixed nut of the ball screw (right) results in axial travel of the shaft as a result of its rotation, and friction during this travel is reduced by the ball spline (left) between the shaft and the surrounding collar

Recirculating Ball Screws and Splines

Although ball screws and ball splines are not a new idea, it is only in recent years, with the advent of new, fast and highly accurate machine tools, that the ball screw and ball spline have come into their own. Today, for instance, the Power Division of Bristol Siddeley Engines is, in agreement with Beaver Precision Products of Detroit, Michigan, regularly producing ball screws with a lead accuracy of 0·0005 in. per foot. Bristol Siddeley has made screws as small as 2 in. long by $\frac{5}{16}$ in. pitch dia., and can now grind screws of 6 in. pitch dia and any required length. Moreover, these have an efficiency in converting thrust to torque, or vice versa, of a minimum of 90%.

Basically, ball screws are similar to ball-bearing races—except for the absence of the retainer. They are designed for the transfer of axial thrust, and so resemble angular contact ball-bearings and, like the latter, the sides of the ball grooves in the screw extend almost to the mid-point of the ball. It follows then, that the mode of failure in ball screws is similar to that of the ball-bearing, primary failure usually being of a fatigue nature.

The rolling action of the ball moves a wave of metal ahead of each ball, causing the raceway stress to change from tension just ahead of the ball to compression at the point of contact and back again to tension just behind the ball. This eventually produces a ruptured effect below the surface of the raceway so that a slight waviness develops, followed by the breaking up of the raceway itself. The design of the ball screw to overcome these factors has been carefully studied, with the object of prolonging its working life.

So far as the static and dynamic load-carrying capacity of the screw are concerned, the same factors which govern the design of ball-bearings are equally applicable to the ball screw.

Many years ago it was pointed out by Hertz that the raceway stress varied with the cube root of the load. However, as the number of stress cycles to produce fatigue failure decreases rapidly as the load increases, the net result is that the life varies inversely as the cube of the load; and ball screw ratings are based on this fact.

The efficiency of a properly made ball screw will consistently exceed 90% and the efficiency in conversion of torque to thrust and that of conversion of thrust back to torque are not significantly different.

A certain amount of end-play is inherent in all ball screws, as the race radius must always be slightly greater than that of the ball. Gothic and ogival groove forms are often used to reduce the axial freedom without greatly increasing the ball pressure, as in these forms the contact angle does not alter so rapidly as with the round groove. As the Gothic groove form does not conform to that of the ball, however, the load-carrying capacity is reduced where this groove form is employed.

In applications where very low values of end-play are essential, preloaded double nuts can be used, just as face-to-face and back-to-back angular contact ball-bearings are employed. By this means, a very long period of service, free from backlash can be achieved.

In the design of mechanisms which employ screws, it is important to bear in mind several vital principles. Wherever possible the line of thrust should coincide with the axis of the screw, so as to eliminate the super-imposition of side loads on the thrust loads. Any side load will cause an increase in the resultant load on portions of the end turns of balls in the ball nut, so shortening the life.

Where a side load is present, it must be allowed for in the same manner as the combination of axial and radial loads is considered in the selection of the ball-bearing. Normally it will be found easier to avoid such loads in the design rather than make the ball screw large enough to withstand them.

Another important point is that ball screws deflect slightly under load and, in some applications, it may be necessary to evaluate not only the deflexion of the screw, but also the deflexions of the balls and raceway. A further point frequently overlooked is the very substantial deflexion of anti-friction thrust bearings under load. This must be allowed for where such bearings are used in conjunction with ball screws.

Due to the high efficiency of ball screws, it is possible in certain applications for the load to reverse as soon as the driving effort is removed. Where this condition is encountered, a device to prevent reversal occurring can, if required, be incorporated between the load and the screw.

New Tecalemit Nylon Hose

The high pressure nylon flexible hose recently added to the existing range of Tecalemit nylon pipes, has met with considerable success. It is used for a wide range of hydraulic and pneumatic applications as well as for high pressure applications where rubber hose has not given satisfaction. It is supplied with re-usable end fittings and is available in bore sizes $\frac{1}{8}$ in., $\frac{1}{4}$ in., $\frac{3}{8}$ in. and $\frac{1}{2}$ in. with burst pressure ranging from 11,000 psi to 7,000 psi dependent on bore size.

The flexing property of this nylon hose is remarkable, the minimum bend radii being $1\frac{3}{4}$ in. for $\frac{1}{8}$ in. bore, 3 in. for $\frac{1}{4}$ in. bore, 4 in. for $\frac{3}{8}$ in. bore and 5 in. for $\frac{1}{2}$ in. bore.

The construction comprises an inner core of nylon tube, braided with high tenacity polyester fibre and having an outer sheath of flexible nylon. This results in a much smaller outside diameter than has hitherto been customary with pressure hose.

X-ray Unit

A new lightweight, portable industrial X-ray unit of 300 kV capacity, known as the Baltospot G300D has been introduced by Pantak Limited, of Vale Road, Windsor, Berks, for examination of mild steel of up to 3 in. thickness. Both insulation and cooling is effected by a chemically and physiologically inert and non-inflammable gas. The maximum dimensions are 40 in. long × 9 in. dia.

The Cavity Surface

Its effect on casting quality and ways of modifying it by the use of die dressings and lubricants

By L. C. BARTON

REFERENCE is frequently made to the importance of this or that individual factor—die temperature, injection speed, locking pressure and so on—in the production of diecast parts. This breaking-down of the problem is, however, only justifiable in that it facilitates discussion, whilst there is the danger that this piecemeal approach may make it appear that each of these variables makes a separate—and separable—contribution to the optimal production conditions. In practice, this is not so, since the several factors react upon one another and a deliberate modification of one results in collateral changes in three or four others. This applies even to purely mechanical factors: for example, the deepening of a gate by a few thousandths of an inch not only alters the time required to fill the cavity, but profoundly modifies the mean temperature of the metal jet. This in its turn may alter the thermal gradient across the die cavity and so make necessary large-scale changes in water-lines, in mean ejection temperature and in the overall production rate.

Because of this complex interaction, single-factor analysis is, at best, one stage removed from the realities of the situation—at worst, it may obscure the true nature of the problems encountered. Fundamentally, the production of superior diecastings demands an integrated understanding of the physics of the casting/cavity interface. The dynamics of metal flow is quite subordinate to this—briefly, what is important is not so much why and how a certain volume of metal reaches a particular location in the cavity, as to know exactly what happens to it when it gets there. The thermal interchanges that take place between injected metal and the die surface determine, in the most general sense, both interior density and superficial soundness of the resultant diecasting.

Anything which affects the nature of the cavity surface, or the character of the contact between metal and mould, also influences directly the transfer of heat from the casting to the cavity face. Such factors are, to name only the most prominent, the mechanical finish imparted to the die surface, the presence or absence of oxide films, tars and inert die dressings, the type and quantity of lubricant present at the surface, if any, and, at least in the early stages of die life, the nature of the heat-treatment to which the cavity insert has been submitted prior to going into service.

A primary requirement is that the cavity surface shall be passive with respect to the diecasting alloy; i.e., it must not react with the alloy at the temperature of injection. If it does, if the alloy "wets" the die, the transfer of heat to the latter is certainly facilitated, but at the cost of local surface roughness on the casting and probably of lowered production and increased downtime. Wetting of the die by the alloy is aptly termed "soldering" and as a production fault is often difficult to deal with. This is because, once soldering has occurred over a specific area of the cavity, it can reappear even after the cause of its original occurrence has been eliminated. In a soldered area, the die surface acquires an adherent film of the injected metal, and after solidification the casting has to be broken away from the affected interface area. The exposed surface is thus, effectively, the same alloy as the casting. By lavish oiling, and keeping the injection temperature low, it may be possible to prevent subsequent castings from welding themselves to the active surface, but only at the cost of perpetuating the area of rough finish, which is transferred from the die surface to each successive component. If on the other hand the tool is taken out of commission, stripped down, and the soldering removed by pickling or polishing, the area thus treated is still left more active and so is more prone to be attacked again. If not all traces of the active interface are removed, and in normal polishing this is very probable, the likelihood of a new attack is very high even if attempts have been made to prevent soldering by altering the gate geometry.

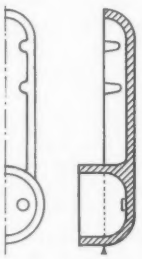


Fig. 1.—(Left). Locating the gate at the point arrowed results in the core eroding, giving a poor finish on the interior of the component

Fig. 2.—(Right). With a horn gate surrounding the core, neither erosion nor soldering is likely to occur

Initially, soldering develops at positions where the mould is overheated by the inflowing alloy, but overheating alone is not enough to cause soldering. Places where a metal stream impinges directly upon the cavity surface—or more often, the core surface (Fig. 1)—may be slowly eroded without any sign of soldering. It is necessary for the development of the fault that the diecasting alloy shall be atomized as it passes the gate and so reach the die surface as a finely-divided, over-heated spray. In this state the alloy presents an enormous area of freshly-formed and highly active droplet surfaces, and the spray as it impinges on the die surface is brought into intimate contact with the passive film which covers it. Where there is the minutest break or weakness in this film, soldering commences. The process of soldering facilitates the break-up and washing away of the film adjacent to the area attacked, and the soldering spreads until it covers nearly all the surface which is at all heavily

sprayed with the atomized metal. Spraying is appreciably reduced by directing the jet tangentially to the cavity or core surface as in Fig. 2.

Soldering is most likely to occur when high pressures are used to inject metal at very high speed through constricted gates. As the impulse to use a very shallow gate usually stems from a desire to minimize gate traces on the finished casting, it is often on those parts which are most critical with regard to surface finish that the fault appears. Changing the gate position to prevent direct impingement often has no beneficial effect, the soldering re-appearing when the die is returned to service. Deepening the gate is more efficacious, for this reduces the tendency to spray formation. This remedy is sometimes resisted because it is felt that by increasing the gate area the rate of filling, and hence the quantity of metal impinging upon the affected surface in unit time, is also increased, and that this must inevitably cause a greater degree of over-heating. This is not the case, for the atomized spray is directed throughout injection at the same area of the surface, whereas when the metal enters as a ribbon-like, unbroken jet, it passes in an undulant manner across the cavity and licks back and forth over the surface with which it comes into contact.

Furthermore, the ribbon of metal has less velocity, and has been less heated by friction in the gate, than the atomized jet produced by the more constricted gate, so that the heat transfer to the die surface, during the time that the metal is directed upon it, is reduced. Certainly this is compensated by an increased heat flow at the later stages of cavity filling, but so far as soldering is concerned it is only the initial conditions which are of importance. Although the profuse application of lubricants assists the removal of castings from the cavity where soldering has already appeared, it often results also in stained castings and, of course, does little to improve the finish of the soldered areas. The application of too great a quantity of lubricant may also impair the soundness and strength of the casting, for if it contains constituents which vaporize at or below casting temperature, the evaporation of these ahead of the inflowing metal causes a high back pressure and increases the filling time.

The interaction of the lubricant and the metal entering the cavity is in fact a very involved matter. In the first place, lubricant in the sprue and runner channels is swept up by the advancing metal and carried toward the gate, where it tends to spread as a thin film over the surface of the jet of metal. Even if the cavity surface is not itself lubricated, therefore, there is still some lubricant between the die and the injected metal; this is often sufficient to ease ejection without giving rise to staining. If the jet atomizes at the gate the position is rather different, for assuming the same quantity of lubricant to be present, the jet area over which it is to be spread is enormously increased. A cubic inch of metal injected through a gate 2 in. wide and 0·050 in. deep presents a surface area of 20 sq in., but if it is injected through a shallower gate and atomizes into globules with a mean diameter of, say 0·062 in., their total surface is around 80 sq in. If the mean diameter is only 0·031 in., however, the surface is in excess of 160 sq in. The more finely atomized the metal, the greater becomes its effective surface and, since each globule contacting the die tends to pick up a complete covering film of lubricant, the more severe the scavenging action at the cavity surface. Where any part of the surface is scoured clean, the highly reactive, newly-formed surfaces of the atomized jet will, if temperature conditions are favourable, alloy readily with the steel of the die.

The use of even excessive quantities of lubricant cannot wholly obviate this result, and the best course is to deepen the gate so that atomization does not occur. If a heavy gate is not practicable, however, the liability to soldering can be reduced by other expedients. One is the slowing down of the metal stream prior to its entering the gate, which can be achieved by constricting the runner near the sprue. This is a step to be carried out with circumspection, since the structure or surface finish of the casting may also be affected. A more worthwhile approach is to produce on the cavity surface an inert film which will prevent alloying between the die and the injected metal.

Such a film does, in fact, build up naturally on dies which have been in operation for some time, and is largely responsible for the "bloom" on the resulting diecastings. The film thus formed is largely composed of metal oxides, and varies in character with the alloys being cast. It forms, and heals if broken, quite rapidly, but does not adequately withstand erosion where the hot jet plays locally upon the cavity or core surface. Because of this, diecasters have always sought ways of producing a more durable film on the die by artifical means. Their aim in this has been not only to prevent soldering, but also to avoid the necessity for a curing period before the die is in a state to produce "hardware finish" diecastings. Many etchants and oxidizing agents have at one time or another been brought into use for this purpose, often with deleterious effects upon the cavity surface.

Some of these methods sought to form a relatively thick inert layer upon the cavity surface, analogous to that produced upon permanent mould impressions by sprayed dressings. Although treatments of this sort, being thermally insulating, do to some extent improve the finish of the diecasting, they are of short effective life and are difficult to re-apply without dismantling and cleaning the die. Furthermore, when they include etchants among their ingredients, they quickly pit and mar the natural die surface. At the present time such treatments appear to have fallen completely out of use.

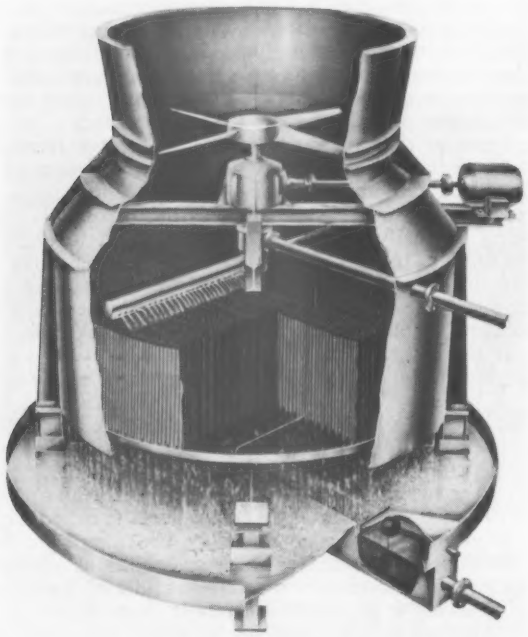
A popular "curing" treatment for die cavities, still employed to a limited extent, consists in the application to the heated die surface of an iodine solution, followed immediately by spraying with hydrogen peroxide and, after the surface has completely dried off, by an oil, wax or silicone sealing coat. This cure is effective in producing a good finish quickly on zinc alloy diecastings, but does little to prevent soldering when the conditions otherwise favour this. A cure more resistant to soldering is achieved by allowing a slight—and carefully controlled—degree of oxidation to take place during heat treatment of the cavity inserts and cores.

There have recently been interesting developments in this field, and at least one U.S. supplier now offers a proprietary die cure which does not call for any pre-treatment before the tool goes into service. Instead, the agents used in the cure are applied in place of an ordinary die lubricant to the cavity surface during the first few hours of operation. This results in the formation of a complex inert film and the immediate production of "hardware finish" diecastings from the treated cavity. Since it often takes a production run of several thousand castings to reach such a result naturally, this treatment is currently receiving a good deal of attention.

U.S. diecasters are also interesting themselves in sulphurization surface treatments for diecasting dies,

since these among their other merits confer what is in effect a cured surface to the die parts treated. European diecasters have for several years made limited but effective use of a sulphurization treatment—"Sulfinuz", an I.C.I. salt-bath process—for cavities as well as cores and other moving parts of diecasting dies. Sulfinuz-treated cavity surfaces are highly resistant to soldering and the development of "drags", whilst ejectors subjected to the treatment do not gall or seize. Dies can accordingly be operated faster and with minimum lubrication, which in most instances results in improved structure and solidity as well as a better surface finish. Good results have also been reported of plungers and shot-sleeves treated in this way.

While there is no question but that the types of die cure outlined above can give extremely good results in experienced hands, they can do little to correct the results of poor die design. Even if a die has a perfectly cured surface, it is essential, for castings of acceptable quality to be produced, that the thermal gradient across the cavity shall not be steep and that all parts of the cavity lie within the optimum temperature range for the alloy being cast. Unless these fundamentals are taken care of, any surface treatment is only a palliative.



A cut-away drawing of the Thermotank cooling tower, showing its mode of operation. Air is drawn up through the channels in the fill by the top-mounted fan, while warm water is sprayed out of the rotating header pipes and percolates through the fill where it is cooled by the counter-flow of air

Thermotank Cooling Tower

A new type of cooling tower which is less than half the weight of conventional towers of similar capacity, has been introduced by Thermotank Limited, Helen Street, Glasgow. The structure is fabricated from rolled steel sections, treated against corrosion, and the casing is of galvanized sheets with side panels which can be removed for maintenance.

The circular tower contains a top-mounted fan which draws the surrounding air up through it from the bottom. The fill, which resembles a honeycomb in its structure, is arranged across the inside of the tower with the channels disposed vertically, and the cooling air passes up through these channels. Water enters the tower at the top and is distributed across the surface of the fill by a centrally-mounted rotating header pipe containing a number of perforations along its length through which the water streams on to the fill. The perforations vary in size along the length of the header to ensure an even distribution of water.

The material of the fill, which was invented by Carl Munters of Sweden, has a high wettability and the water passes down the walls of the channels in a thin, continuously-moving film. A catchment tray at the base of the tower collects the cooled water for return to the appliance in which it is required.

Initially these Thermotank cooling towers are being made in twelve graduated sizes, the largest of which can deal with up to 90,000 gph; yet it has a diameter of only 20 ft, a height of 12 ft, and a total weight of 9½ tons.

The fill is made from alternate flat and corrugated sheets of a plastics-impregnated cellulose material, made up into rigid units which require only a very light supporting structure at the base. The entire internal area of the tower can, therefore, be occupied by the fill without need for bracings.

Two grades of fill are made, with two sizes of channel, the larger having a spacing of only a little more than ¼ in. Drainage from the bottom of the fill is accomplished by a patented feature providing for serration of the lower face, which breaks the capillary bond and allows the water to run easily off the tips of the fill.

New Tecalemit Filter Element

New ribbon filter elements for high flow rate, efficient filtration of air, water, petrol, oil, or other liquids where the particle to be removed is in the order of 40 microns and above, are now being produced by Tecalemit Limited, Plymouth, Devon.

Simplicity of production and high flow rate ensure increased efficiency at reduced cost. The element consists of a ribbon of resin-impregnated creped material helically wound edgewise on a rotating mandrel and electrically polymerized and fused to form a hollow, open ended cylinder. The corrugations of the ribbon form numerous passages between adjacent turns of the helix, through which the fluid can flow freely whilst the foreign matter is retained on the ribbon edges, inside or outside the cylinder according to the direction of flow.

In addition to the qualities mentioned above these elements have a further feature, in that they are easily cleaned for further use by washing in petrol or paraffin, or by blowing through with an air line. When conditions allow, a reversed flow of clean fluid or compressed air can be passed through the element, forcing the particles away from the ribbon edges and out through the drain valve.

Elements will be available in sizes varying in outside diameter between ⅜ in. to 6 in. and having a wall thickness varying from $\frac{3}{32}$ in. to ¼ in.

These new elements are also incorporated in a range of air breather filters for crank-cases, gear and axle housings, vacuum and air brake systems, hydraulic reservoirs, pneumatic cylinders, etc.

Research into Tool Steels

In comparison with heat-resisting alloys and materials, tools and tool steels have taken up less of the research-worker's time; all the same, investigations into little-known or not so well-known aspects of these steels continue. In the following notes details are given of some of the more important results

WHEN a high-speed steel has been overheated, its microstructure presents certain peculiarities. Among these is a proportion of particles of carbide which have an angular shape. It was known some years ago that the presence of these particles was liable to lower the ductility of the steel as well as impair other properties. Further research established that they began to appear when high-speed steel was heated for long periods at a temperature in the region of 1200° C. The dimensions and angularity of the particles depended on the period of heating at this temperature, and after they had appeared it was impossible to disperse or disintegrate them by either cold working or additional heating. They were found in both ordinary 18% tungsten high-speed steels and steels of a lower tungsten content.

It was decided that more ought to be known regarding these carbides, so that some years ago further research was carried out. This demonstrated that the form of the particles is governed by both the time and the temperature of heating. It was found possible to produce a microstructure consisting of almost 100% angular carbide, which suggested that a full 100% was not impossible. It was found that the particles did not differ in grain structure from the normal particles, which have a more globular form, and have virtually identical composition.

Another interesting series of researches has been into grain growth in high-speed steels. There is a type of defect in these steels, quite well known, termed a 'fish-scale fracture'. This is the result of hardening a high-speed steel, and then rehardening it, which produces a marked grain growth in the steel, and at the same time makes it extremely brittle. High-speed steel is not often rehardened, so that no great concern has been caused in the past by this occurrence; but sometimes a steel has not been properly heat-treated or needs to be softened for additional machining, and rehardened afterwards. In these instances, the trouble is often overcome by full annealing before re-hardening.

Nevertheless, no one knew accurately what was the cause of this type of fracture, and it was decided to find out. Research was accordingly begun, and we now have the results. These reveal that the cause is a phenomenon of *discontinuous* grain growth associated with a restoration of the austenitic microstructure of a previously hardened high-speed steel. The temperature at which this coarsening of the microstructure takes place, as well as the size of the over-large crystals, are related directly to the temperature at which the steel was first quenched.

Furthermore, another interesting point emerged, which was that if high-speed steel had enlarged grains as a result of a second hardening, it would still have these coarse grains after a third hardening. All the same, this did not mean that the grain structure could not be restored by a number of annealings, though it did mean that the grains would in no circumstances be as refined as if the overheating had never taken place.

One of the most fascinating and intensive investigations of recent years has been into the possibility of predicting the hardenability of steels, and particularly of carbon tool steels. A prediction of hardness contours in steel cylinders of a comparatively shallow hardening carbon tool steel might, it was thought, be made from a series of curves based on a determination of cooling rates at various positions in these sections during quenching. It now appears that such curves can be successfully produced and applied to various problems of hardenability.

There are, however, a number of points to be borne in mind. The heat-treatment of the carbon tool steel cylinders, including their pre-treatment, must be the same as that of the test pieces on which the curves were based. The hardening temperature must not exceed 800° C. The curves so far obtained apply only to steels with a critical hardness of 55, Rockwell C. The steel should have been pre-treated for 40 min at 870° C and oil-quenched, and the carbon content should be 0·9%. Bar diameter affects the application of the curves.

A term frequently used in connexion with tool steels, and particularly high-speed steels, is 'red-hardness', which is ability to retain a keen cutting-edge when subjected to elevated temperatures. This phenomenon is fairly well understood, its cause being the formation and precipitation of alloy carbides when the martensite in the microstructure is heated to a sufficiently high temperature, as long as the steel has first been heated to such a temperature that the alloying elements it contains have been taken into solution in the austenite before it is cooled to form martensite.

We were still, however, not sufficiently acquainted with the mechanism causing the changes in mechanical and physical properties occurring during the tempering of alloy martensites. Some light has now been thrown on this by recent researches, but there are still many questions remaining to be answered. We know now that secondary hardening in alloy martensites occurs as a result of a coherent precipitation of alloy carbides. The type of carbides is governed by the composition of the steel, and iron carbide may be also be found with the alloy carbides throughout all or most of the tempering temperature range until we reach a point beyond the secondary hardness peak.

We have also learned that red hardness is caused when the increase in alloy content in the carbide occurs without any change in structure. Later, there may be a change of structure, but by then the steel is already softer. Another interesting fact is that steels in which chromium (only) forms carbides, a genuine secondary hardening does not take place, even though some red hardness is found when the steel is tempered at 480° C for a comparatively short period. Why this should be is still unknown. Summing up, the theory is that each alloying element forming carbides produces separate carbides, and that some time is required for their individual precipitation. It is this 'period of gestation' that is believed to be respon-

sible for 'red hardness', and the period itself depends on a balance between the carbon and alloy content of the steel. Why this is, is also unknown.

Some tools are manufactured from a 1% carbon steel, which is alloyed and case-hardened. It has long been desired that data could be ascertained which would enable the hardenability of carburizing steels of this type to be foretold when quenched direct from about 930° C.

This is not a common temperature for case-hardening alloy steels, but research was initiated, and as a result the influence on hardenability of a number of alloying elements has been reasonably precisely determined for steels of 0·2% and 0·7% carbon. These apply only to steels austenitized at about 830° C, which have been heated for 35 to 40 min at this temperature. Variation in grain size modifies hardenability in these steels, and must therefore be taken into account as a small error in evaluation. The multiplying factors used in the predictions apply only to certain limits of alloy content, and any nickel over and above 1·5% greatly increases the hardenability effect of other alloying elements.

In short, it is claimed that for a carbon steel of 1·0% carbon, to which is added manganese, silicon, chromium, nickel and molybdenum, either individually or combined, hardenability can be calculated for an 830° C quench with an accuracy of ±15% at Di ("ideal diameter") values of 7·0 in. or less.

As experience is gained in the employment of these factors, and as more knowledge is acquired regarding the hardness indices to associate with specific types of carburizing steels, the calculation of carburizing ability will become as valuable as calculation of the hardenability of medium carbon steels, it is claimed.

We now turn to a somewhat different aspect of tool steel research. Many works, for different reasons, subject tool steel parts to an abrasive tumbling process. Little has been known in the past concerning the actual distribution of residual stresses as a function of depth below the tumbled surface. It was decided for this reason to discover how these stresses were distributed, how they were influenced by conditions of tumbling and by the work-piece and any initial stresses it might contain.

Without going into elaborate detail regarding the research techniques evolved for this purpose, we may say that it has been found that the residual stresses are uniformly compressive in all directions, becoming smaller from a maximum at the surface to zero at a depth of a few thousandths of an inch. As the particle size of the abrasive employed becomes larger, so these stresses increase while at the same time the depth to which they penetrate becomes greater. As the steel declines in initial hardness on the surface, so the maximum compressive stress declines, as does the depth of penetration.

It has been found that there is not much difference encountered when the type of abrasive used is changed, even if a manufactured material is substituted for a natural abrasive. On the other hand, when the steel is burnished with steel balls, the stress patterns are characteristically different from those produced by abrasive particles of the same size.

An effect of abrasive tumbling is to eliminate residual stresses caused by grinding or heat-treatment, and to substitute for them the compressive stresses referred to. The extent of this stress replacement is a function of particle size and steel hardness, in just the same manner as when stress-free steel surfaces are tumbled. It will be seen, therefore, that abrasive tumbling always has the effect of modifying the stress condition of steel surfaces and these changes are favourable to improved fatigue strength.

There is still room for a great deal of research into abrasive tumbling.

Further research has been carried out into the discontinuous grain growth of high-speed steel. Important observations have been made as a result. For example, it is apparent that both continuous and discontinuous grain growth occur on rehardening and if a low pre-quench temperature is employed, continuous grain growth takes place. A minimum grain growth temperature exists for pre-quench temperatures in the region of 1150° C, and as this pre-quench temperature increases, so the size of the grains increases in the steel, up to a maximum just a little above the grain-growth temperature. The grain size established at 870° to 1100° C when high-speed steel is reheated after pre-quenching at 1150° C or above is the same as that of the original austenite.

Annealing raises the coarsening of the microstructure to higher values, and the same is true of a long tempering period or regulated slow heating ending in a single quench. Martensitic constituents must proceed discontinuous grain-growth. Annealing has the effect of refining and reducing the coarse grains, and a number of such annealings continues to give the grain a small amount of additional refining.

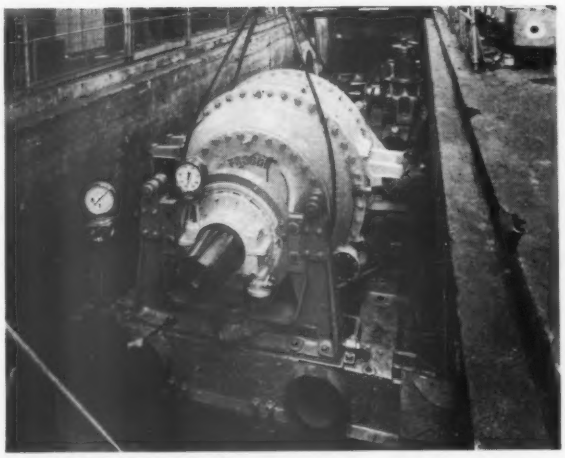
The discontinuous grain-growth does not in itself affect the hardness of the steel after quenching or the hardness of high-speed steels when tempered. It is found in steel for hot working containing 9% tungsten, but not in alloy steels of lower tungsten content, such as those used for some tools and dies. Discontinuous grain growth must, apparently, be preceded by or be found in conjunction with the presence of subgrain boundaries.

It will be seen from what has been written that much remains to be learned regarding tool steels, but research is still going on.

Gearbox for Mixing Duties

In large mixing tanks and closed pressure vessels it is usually necessary to have bottom bearings on shafts longer than 15 feet with the attendant problems of certain and adequate lubrication and maintenance. The new range of Agidrive gearboxes introduced by Chemical Equipment Engineering Limited, Macclesfield, are specially designed for agitation work and allow for overhung shafts of up to 20 to 25 ft length free of whip and without any bottom bearing. The elimination of a bottom bearing with such great shaft length has been achieved by the much wider spacing of the bearings inside the box than is usual in gearboxes of equivalent size. The standard output shaft is designed to promote rigidity, being 30% to 50% larger than the equivalent conventional worm gearbox. If desired, the standard shaft sizes can be increased without major modification to the internal design and working parts.

A wide range of agitator speeds may be obtained between 16 to 400 rpm by pick off gears which are readily accessible by the removal of a light alloy cover and, in conjunction with high efficiency worm gearing eliminate V-rope drives between motor and gearbox. Up to 100 hp can be transmitted safely and continuously.



30,000 bhp dynamometer for Denmark: the carcase positioned in its bed-plate

30,000 hp Dynamometer

The largest and most powerful dynamometer ever exported from Britain has been delivered to Denmark by Heenan & Froude Limited, of Worcester. The dynamometer is a Froude FA 16 D hydraulic machine, capable of absorbing and measuring up to 30,000 bhp at speeds between 100 and 225 rpm. It is to be installed at the Copenhagen works of Burmeister and Wain, the marine engine builders, where it will be used for testing the largest marine diesel engines yet made in Europe.

In relation to its larger power-absorbing capacity the dynamometer is notably compact. It weighs over 80 tons, and because of cranage capacities, it was sent to the Gloucester works of Heenan & Froude's sister company, Fielding & Platt Ltd., for assembly.

The new machine will permit engines of either direction of rotation to be tested by coupling to the appropriate end of the dynamometer shaft. It incorporates two rotors, each running in its own water-tight compartment, and each arranged with cups. When driven by the engine, the rotors set up a hydraulic resistance which reacts equally upon the dynamometer casing. The reactions arising from the friction of the shaft bearings and glands are similarly transmitted to the casing. Measurement of these forces is achieved with practically 100% accuracy by torque-reaction weighing gear connected to the casing. In this instance, because of the very heavy forces to be measured, the gear used is of the Heenan hydraulic type which needs only small balance weights and may be arranged with the indicating head remotely mounted.

By virtue of the patented Froude control gear exceptionally stable conditions of dynamometer load and speed are given at any setting, and remote control is provided by a system of push-buttons and electrically operated valves. Speed indication is provided by a mechanically driven tachometer.

An interesting feature of the torque measuring gear is that, even at maximum load, it causes no additional load on the casing trunnion bearings; frictional resistance to the movement of the casing is thus reduced to the minimum, and this contributes to the high accuracy of the torque readings.

When installed and operating at full power, the dynamometer will require a water supply of 120,000 gph.

High-duty Mouldable Refractories

The accepted trend in furnace operation today is towards higher output, higher temperatures and more severe operating conditions. Unless the refractories used keep in step with these demands, heavy maintenance costs and shut downs may well wipe out the advantages gained by extra efficiency and higher output. Moreover, refractories in poor conditions tend to push up fuel consumption and in this respect there is a direct connexion between the efficiency of fuels and the quality of refractories.

The obvious answer, therefore, is to use refractories which will stand up to these higher demands and in fact it is the rapid improvement in refractories that has made modern furnace design possible. These super-duty refractories require extraordinary care in manufacture and are sometimes more expensive: but in any furnace at all hard driven, they quickly save their cost.

Super-duty refractories are usually thought of in the form of squares and shapes, kiln fired during manufacture, but Morgan Refractories Limited, of Neston, Wirral, Cheshire, have developed a range of castable and mouldable refractories that can be fired *in situ* and yet have a performance comparable to that of the best super-duty pre-fired refractories. This is called the TRI-MOR range of castable and mouldable refractories.

With these refractories it is possible to obtain the advantages of monolithic construction (freedom of design, efficiency and shape) combined with a performance (in terms of long life and low maintenance) that may be even superior to that obtained from high grade pre-fired bricks and shapes.

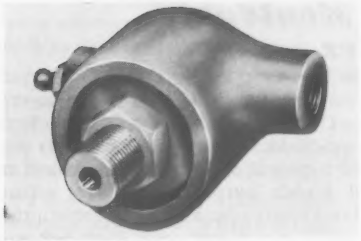
Transistorized Metal Detector

A transistorized metal detector, for detection of ferrous and non-ferrous metal inclusions in packaged food, biscuits, powders, and the like, has been introduced by Metal Detection Limited, Moseley Street, Birmingham 12. It eliminates the "warming-up" period required with valve circuits, has a smaller power and H.T. unit, giving a more compact and robust design, is instantaneous in operation and is operationally safe.

The detector is made in a range of sizes to suit belts from 6 in. up to 24 in. wide, and aperture heights up to 8 in. The power supply (240 volts, 1 phase, 50 cycles) and relay stage are housed in a wall-mounting cabinet, whilst the oscillator and ancillary circuits are incorporated as part of the search coil assembly.

Pneumatic and Hydraulic Controls

The range of control equipment manufactured by the American companies of Skinner, Rivett, Oil-Dyne, Atkomatic and Allenair is now available in Great Britain through the agency of British Arca Regulators Limited, Sisson Road, Gloucester. Skinner Solenoid valves are designed for almost any flow application with a wide variety of media; air, oil, water, inert gases, hydraulic fluids, kerosene and petroleum. The Rivett range of equipment comprises 700 standard models of valves and cylinders for use with pneumatic or hydraulic systems. Oil-Dyne offers a range of compact hydraulic supply units comprising motorized pump on a reservoir together with all necessary valve gear. The Allenair pneumatic and hydraulic equipment covers a wide range of valves and cylinders.



Rotating Air Connexions

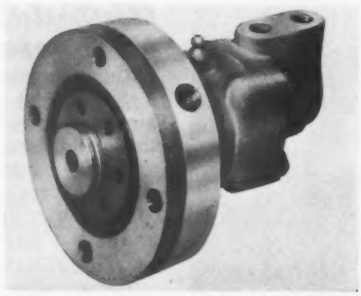
Brief mention was made in the article "Pneumatic Control Equipment" on page 528 in our issue of December last, to the "Rotorseals" newly introduced by the Westinghouse Brake & Signal Company Limited, 82 York Way, King's Cross, London N1. We are now able to give details of these devices for transferring an air supply from a stationary source to a rotating member of machinery or plant, an example being found in mechanical excavators where single, double and quadruple pipe versions with speeds ranging from 10 to 1000 rpm are successfully used. These units require little or no maintenance and are designed for maximum operating pressures of 120 psi.

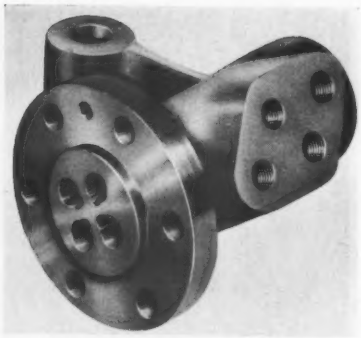
The single pipe Rotorseal construction (Fig. 1) comprises a body casting fitted with a combined oil/air seal and a spacer ring. Fitted into the body is the rotating spindle assembly, consisting of the spindle, a twin row ball bearing, and a bearing cover; the latter item containing an oil retaining felt ring. The assembly is locked together by a circlip, and a further circlip retains the assembly in the body. A grease nipple is provided in the body for lubrication purposes. The maximum speed is 1000 rpm.

The two-pipe Rotorseal (Fig. 2) was specially developed for a leading excavator manufacturer for conveying the air supply to the rotating winch clutches. The speed of this model is 1000 rpm maximum.

The four-pipe Rotorseal contruction (Fig. 3) comprises a flanged rotary spindle housed in a stationary body. The body is open ended and contains the four grouped pipe connexions for the stationary air supply. Five cruciform section sealing rings spaced either side of the annular grooves in the spindle prevent leakage of air from one line to another.

The rotary spindle is flanged at one end for bolting to the operated





The Westinghouse range of Rotorseals enables an air supply from a stationary source to be fed into a rotating shaft for distribution to one or more services. The range consists of single (Fig. 1, left), twin (Fig. 2, above) and four-pipe (Fig. 3, right) versions

device, and is retained in the body by a circlip at the opposite end to the flange. Four drillings in the spindle match up with their appropriate pipe connexions and thus the transfer of the air supply is achieved. The speed is 10 rpm.

New Range of T.E.F.C. Motors

New totally-enclosed, fan-cooled, industrial a.c. motors with Class-E insulation, which develop up to twice the power of previous standard totally-enclosed machines of equivalent frame size, have been introduced by Crompton Parkinson Limited, Crompton House, Aldwych, London WC2. Rating for rating, these new motors, designated Series 5 T.E.F.C., are substantially smaller and lighter and on average 9½% lower in cost than the machines they supersede. Electrically, the motors conform to BS 2613:1957 Class E insulation. Dimensionally, they conform to a new draft British Standard and their fixing dimensions are the same as Series 5 ventilated motors to BS 2960:1958.

An entirely new design of cooling is used which promotes a very high velocity stream of air which, as smoke tests show, remains in intimate contact with the motor carcase over its whole length. Rapid transfer of heat from the centre to the outside of the motor is promoted by, among other factors, an interference fit of the stator stamping packs in the housings. So efficient has the cooling system proved to be that with smaller motors in the range—up to Frame 184—it has been possible to dispense with the usual longitudinal cooling fins on the outside of the motor carcase.

The standard rotor is suitable for the majority of normal applications, but by variation of the rotor design, it is possible to provide different starting characteristics to suit special requirements of driven machines. Typical of these special designs are high torque rotors for applications involving a large amount of static friction, and high slip rotors for fly-wheel drive applications.

P.T.F.E. Adhesive Tape

Adhesive-backed P.T.F.E. (polytetrafluoroethylene) tape is now available from the Fluorocarbons Department of A.E.I. Radio and Electronic Components Division. Bulk quantities can be supplied in sizes up to 2 in. in width and 0·015 in. thickness. Equipment now being installed will enable greater widths and thicknesses to be available in the near future.

The material has very useful adhesive properties when applied cold. The surface to which it is to be affixed is first thoroughly cleaned and after the backing paper has been removed the tape is pressed firmly into position, with pressure applied from the centre outwards to avoid trapping air.

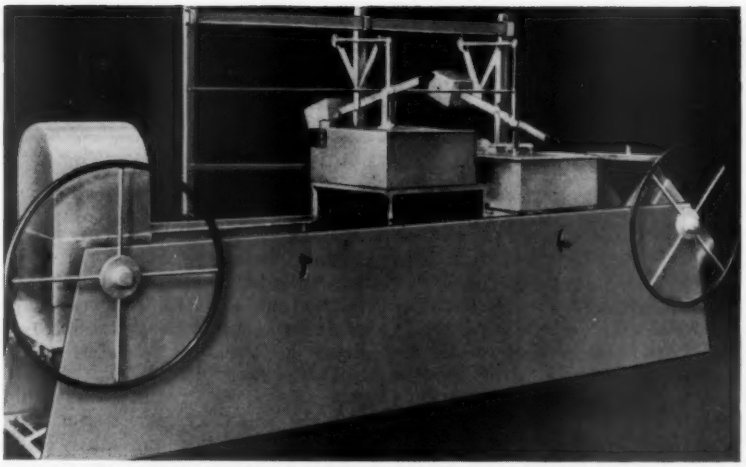
The bond strength can be increased further if, after the tape has been applied as described, the assembly is heated to approximately 200° F for 20 min. To obtain maximum bond strength an additional 5 min heating at 300° F is required. After this the material should be left to stand for 24 hr.

Samples applied to shim steel by this method have shown peel strength of the order of 2 lb. per in. width, and sheer strength of between 12-20 psi. The adhesive becomes thermoplastic at temperatures in excess of 150° C, but retains useful adhesive attributes up to 200° C. Resistance to acids and alkalis is good, but the adhesive is affected by most organic solvents.

New Shell Moulding Equipment

The Efco Foundry Division has introduced two new shell moulding equipments—the Reynolds shell moulding machine which is a manually operated unit for producing good moulds consistently, and the Reynolds shell mould closing machine for the rapid positive closing of the two halves of a mould. Both machines are simple to operate and can be used by relatively unskilled labour.

The shell moulding machine has two investment boxes and two heating units for making the two halves of a mould. The boxes are positioned at each end of a steel framework which has at the centre an idling position for the heaters. The framework provides a horizontal track on which the pattern plates, mounted on rollers, can be moved quickly from the heating positions to their investment boxes. The heating units are fitted with electric elements providing rapid heating by radiation. They are suspended from a rear framework and are easily moved in any direction.



The Efco-Reynolds shell moulding machine showing the two heater units, one in the central idling position, the other heating a pattern plate ready to be fixed to the open end of the investment box on the right. The left hand box is shown in the dumping position

The shell mould closing machine showing a mould being held in the press. The table at the back is in one of the two loading and unloading positions

When a pattern plate has been heated to the required temperature the heating unit is removed to the idling position and the plate is moved to its investment box where it is tilted at the right angle for securing it to the open end of the box with quick acting clamps. The investment boxes are up-ended with large diameter hand wheels to provide the dumping action which compresses the sand to the shape of the pattern. After 8 to 15 sec, depending upon the thickness of shell required, the box can be moved back to its original position and the invested pattern plate returned to the track where it is again covered with a heating unit to complete the curing of the resin impregnated sand. The shell is finally stripped from the pattern by spring loaded plungers brought into action with a foot lever.

The moulding machine will make shells up to 18 in. by 14 in. One operator can produce 25 complete moulds an hour.

The shell mould closing machine is designed for joining with a resin adhesive the two halves of a mould received while still hot from the moulding machine. The shells are placed in one of two loading stations where they are supported on spring-loaded plungers, liquid or powdered thermo-setting adhesive having been applied to the lower half mould. The moulds are accurately positioned against stops. The loaded station is moved into the closing press where a top plate, equipped with a corresponding set of plungers, is raised and lowered by a pneumatic cylinder. The press is closed and the adhesive sets in a few seconds. The loading stations are used alternately, as one is moved into the press it pushes the other to an unloading position.

The machine is fitted with two side tables where the hot shells from the moulding machine can be placed, face down, until they have passed the thermo-plastic stage and can then be supported on the plungers.

The machine will accommodate half moulds up to 6 in. deep and any reasonable number of plungers may be used. Output of the machine depends upon the setting time of the adhesive which can be as short as 30 sec when a single operator can easily close a hundred moulds an hour.

Packaged Oil-gas Plants

A new process for the gasification of petroleum oil has been developed by The Incandescent Heat Company Limited, of Smethwick. The process is continuous and does not employ catalysts. Cracking heat is supplied by burning oil and waste products in a compact and simple furnace setting. The oil to be gasified is injected together with steam into a system which is specially designed to enable a uniform and precise control of cracking temperatures to be exercised. By these means the production of unwanted by-products (particularly carbon and tarry condensates) can be kept to a minimum; more particularly, the calorific value of the gas produced can be varied continuously in the range 500 to over 1,200 Btu per cu ft. The gas is interchangeable with natural gas or coal gas of similar calorific value. Results obtained with a heavy distillate oil indicate that this system can be operated economically over a wide range of throughputs.

technique

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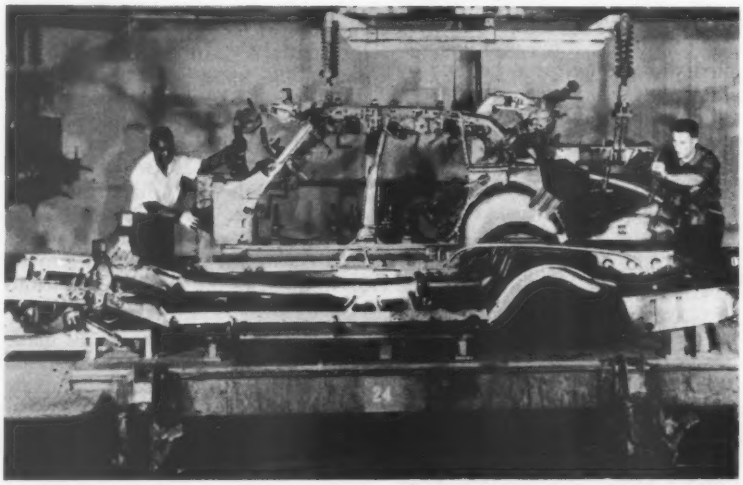
Precision Fitting in Car Assembly

Precision fitting of every part of the car is the outstanding feature of a new linked automation assembly system introduced by the Chrysler Corporation at its body plants in the United States. Known as the gate-line system, it is being used in the assembly of the Corporation's compact car, the Valiant.

The gates — large mechanized clamps attached to each side of the assembly line—contain all the components of the car. The unitized body is built up on a large platform which travels along a track laid out on the factory floor. As the various components of the car are automatically fitted into place, they are welded by workers on the line.

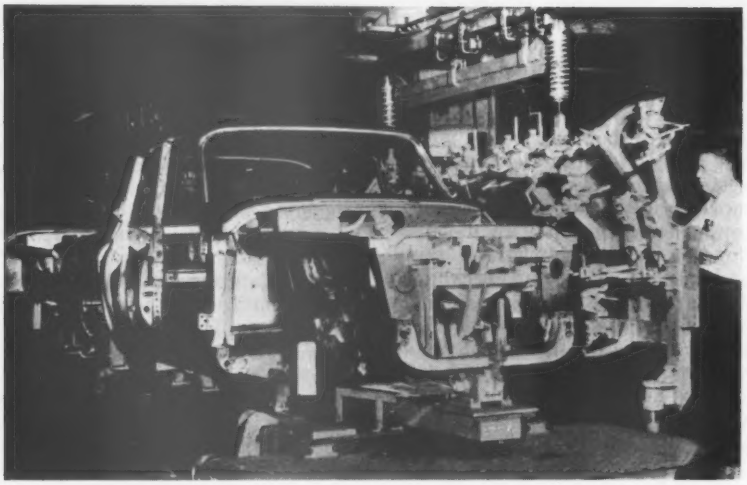
When all basic components have been fitted the gates are diverted to another part of the assembly shop and reloaded. Meanwhile the platform continues along the line as engine side assemblies and front bumpers are fitted and spot, arc and gas welding is completed. Wire brushing, soldering and grinding operations are carried out before bonnet, bumpers, doors and boot lids are added. The unitized body is finally removed from the platform and then taken to the metal finishing line.

This system is still further improved by a special heavy-duty welding which is carried out with heavier guns than previously used with the current raised from 50 to 75 and 150 kVA. The increased pressure and higher amperage ensure higher quality welds.



In the gate-line method of assembly (right) of the Chrysler Valiant the entire car from end to end and top to bottom is assembled on a moving track. Two clamps bring the many parts of the car together in a perfect fit. The right hand clamp is shown above moving towards the floor pan with all essential parts in the clamp in unison ready for welding

(Below). A complete unit-constructed Valiant body leaves its assembly clamps at this point. The right-hand clamp has rolled away and a foreman unlocks the left-hand clamp. The car is now a fully unitized vehicle and continues along the line to receive the bumpers, bonnet, doors and boot lid



Polishing Stainless Steel in the Production Line

Metal finishing is particularly important in the manufacture of metal kitchen equipment. At the new pressing works of Leisure Kitchen Equipment (a member of The Allied Ironfounders Group), pressings are mechanically conveyed from the presses through the degreasing plant after the first stage of pressing, and then sprayed and dried. After degreasing stainless steel pressings are annealed at 1000°C and are pickled in hydrofluoric acid solution.

A certain amount of seam welding is carried out by continuous seam and stitch welding methods. The preweld surfaces of the bowls are prepared for welding by Hicycle sanders in a shop adjacent to the annealing annexe, current being drawn from an A.E.I. 5kW frequency changer. Two further A.E.I. 10 kW frequency changers serve Hicycle polishers which are employed in the first stage polishing room.

Pressings for enamelling are taken successively through shot blasting plant and grip coat dip baths. After firing of the first coat, the colour coats are fused in a 1350 kW continuous furnace. The stainless steel pressings are polished in a number of stages using Consolidated Pneumatic Hicycle high frequency electric sanders and buffers, 6-in. dia mops

being used. The sequence of polishing starts with the use of calico mops dressed with 80-grit Aloxide, this being followed by further mops dressed with finer grits down to 180 Bauxilite. Felt wheels, lubricated with bobbing grease and dressed with 140-grit emery are then employed, followed in turn by calico mops dressed with 240-grit emery. The final stages employ brushes in conjunction with various types of fine polishing media.

The Best Size for a Drill

An exhaustive investigation into the torque required for tapping holes and into the strength of tapped assemblies carried out by The Production Engineering Research Association, has resulted in the appearance of an informative report (PERA Report No. 13, Part I) on the relationship between core hole size, tapping torque and thread strength.

It is well known that it is not practicable to tap a hole with a core size equal to the minor thread diameter of the bolt—in fact, in many materials it is quite impossible. Because of this it is customary to drill the core hole to a "percentage depth of thread", but just what the percentage depth has been is a matter for experience. The new PERA report puts the choice on a rational basis.

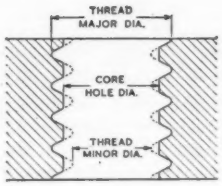
The tests confirm that the tapping torque decreased as the core hole size increased.

In low carbon steel and stainless steel, if the depth of the tapped hole is equal to the thread major diameter, if the percentage depth of thread is 60% or more, then the tapped threads are stronger than a 65–70 ton per sq in. high tensile steel bolt.

Where the depth or length of tapped hole is equal to or greater than the thread major diameter, the strength of the threaded assembly is not increased by providing a depth of thread greater than 60% in aluminium alloy and 75% in cast iron.

The strength of B.S.W. threaded assemblies is lower than that of the corresponding B.S.F. threaded assemblies where the depth, or length, of tapped hole is equal to the thread major diameter, and the torque required to tap the B.S.W. threads is higher than the torque required to tap the B.S.F. threads.

The report makes the following recommendations:



Percentage Depth of Thread $= \frac{A}{B} \times 100$

where

A = Thread Major dia. — Core Hole dia.

B = Thread Major dia. — Thread Minor dia.

Definition of percentage depth of thread

When specifying tapped threads, B.S.F. threads should be selected in preference to B.S.W.

When tapping steels and aluminium alloys, the depth of thread should be 60%. When tapping cast iron the depth of thread should be 75%.

When tapping steels, the depth or length of the tapped hole should be equal to the thread major diameter.

PERCENTAGE DEPTHS OF THREAD AND CORRESPONDING DRILL SIZE

Thread Size	Stock Drills				Percentage Depth of Thread
	in.	mm.	Wire or Letter	Equivalent Dia. in.	
2 B.A.		3.95*	23*	0.1540	81
				0.1555	77
				0.1562	75
		4.10*	20*	0.1610	63
				0.1614	62
$\frac{1}{16}$" B.S.F.				0.1562	78
			22*	0.1570	76
		4.00		0.1575	75
			20*	0.1610	66
		4.10*		0.1614	65
		4.15*		0.1634	60
$\frac{1}{8}$" B.S.F.		5.40*	3*	0.2126	76
				0.2130	75
		5.60*		0.2188	63
			2*	0.2205	60
				0.2210	59
$\frac{5}{32}$" B.S.F.			H	0.2656	81
		6.80*		0.2660	80
		7.00		0.2677	77
			J	0.2756	63
				0.2770	61
$\frac{3}{16}$" B.S.F.			P	0.3230	81
		8.25		0.3248	78
		8.30*		0.3268	75
				0.3281	73
		8.50		0.3346	63
$\frac{7}{32}$" B.S.F.		11.10*		0.4370	79
				0.4375	78
		11.40*		0.4488	64
				0.4531	59
$\frac{1}{4}$" B.S.F.		14.00		0.5512	81
		14.50		0.5709	59
$\frac{9}{32}$" B.S.F.		17.00		0.6693	76
		17.25		0.6719	73
				0.6791	66
				0.6875	59
1" B.S.F.		23.00		0.9055	74
				0.9062	73
		23.25		0.9154	66
				0.9219	61
$\frac{1}{16}$" B.S.W.		3.70*	26*	0.1457	78
				0.1470	76
		3.75		0.1476	75
		3.90*		0.1535	64
			23*	0.1540	63
		3.95*		0.1555	60
				0.1562	59
$\frac{1}{8}$" B.S.W.		5.10*	7*	0.2008	77
				0.2010	77
		5.30		0.2031	73
			4*	0.2067	65
				0.2090	64
$\frac{5}{32}$" B.S.W.		6.50	F	0.2559	80
				0.2570	78
		6.60*		0.2598	74
			H	0.2660	65
		6.80*		0.2677	63
$\frac{3}{16}$" B.S.W.		7.90*		0.3110	80
				0.3125	78
		8.00		0.3150	75
				0.3230	65
		8.25	P	0.3248	63
		8.30*		0.3268	60
				0.3281	59
$\frac{1}{4}$" B.S.W.		10.60*	Z	0.4130	81
				0.4173	78
		11.00		0.4219	73
				0.4331	63
				0.4375	59
$\frac{5}{16}$" B.S.W.				0.5312	81
		13.50		0.5315	80
		14.00		0.5512	63
$\frac{3}{8}$" B.S.W.		16.50		0.6496	78
				0.6562	73
				0.6719	61
1" B.S.W.				0.8750	78
		22.25		0.8760	78
		22.75		0.8957	65
				0.9062	59

*These drills are not usually available with taper shanks.

When tapping aluminium alloy or cast iron, the length or depth of the tapped hole should be 1½ times the thread major diameter.

As a guide to the selection of drills, the accompanying table gives drill sizes and corresponding depths of thread.

The strength of a threaded assembly is related to the cross-sectional area at the minor diameter of the bolt. Over a range of thread sizes, the strength of the bolt will vary with the ratio of the minor to the major diameter. For example, the ratio, expressed as a percentage, is 83% for a ⅜ in. B.S.F. bolt and 87% for a 1 in. B.S.F. bolt. Allowance for this variation and the possibility that the threaded assembly may consist of components manufactured from materials of different ultimate tensile strength, has been included in the recommendations for core hole size and the depth or length of tapped hole.

These recommendations do not necessarily apply to threads for use in assemblies where resistance to fluid pressure is important.

Where threads are likely to work loose due to vibration the usual precaution of locking the nut should be taken.

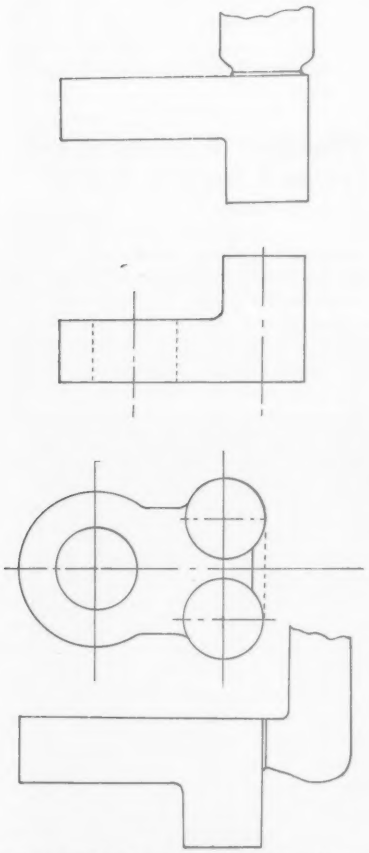
Timber Extraction from Chance Cone

A simple means of eliminating timber from the coal flow through a coal preparation plant, devised by Mr. T. Emrys Smith, manager of Cwm coal preparation plant, has proved very successful in use at Nantgarw. Mr. Smith's idea involves the cutting of an opening 9½ in. wide in the side of the Chance cone at the washery. A short water chute is attached to the outer side of the opening, so arranged that the bottom of the chute is two inches below the normal water level of the cone. The chute discharges on to a specially fabricated dewatering screen fitted with a vibrating mechanism. When the cone is in operation, water flows out of the opening on to the screen, carrying any timber with it. The action of the screen conveys the timber over a ½ in. wire mesh and discharges it into a chute while the water, with some sand, is carried from the screen outlet, through a pipe, to the sanding screen hopper. Incorporation of this device in the washery circuit prevents any trouble from timber at the roll crusher in the clean coal circuit.

A Note on Casting Design

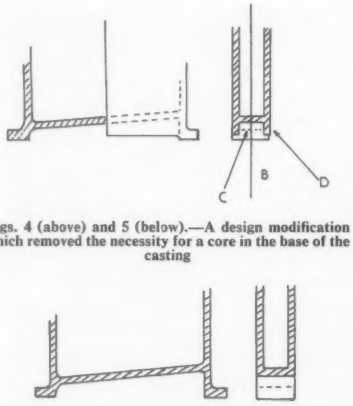
Design affects the manufacture of castings considerably and it behoves the engineer to overhaul his designs and ascertain if by slight modification he can assist the foundryman to produce his requirements quicker and cheaper.

Particularly is this true of steel casting and those produced from high duty iron in place of the ordinary grey iron. As an example, Fig. 1 shows a particular bracket required in high duty iron which had to be sound in the bosses and of uniform structure throughout. To achieve this, it was necessary to employ a feeding head to form a reservoir of live metal to compensate for the liquid shrinkage of the metal forming the bosses. This called for the employment of a top self-feeding riser as shown in Fig. 1 which because of its shape had to be hand rammed. As this casting was required in large quantities the time taken in making by hand moulding was high and deliveries protracted. It was not economic to make on a moulding machine, as only the bottom half could be dealt with satisfactorily, the top still having to be hand rammed to facilitate the formation of the riser. A slight modification, just the adding of metal between the bosses as shown by the dotted line in Fig. 2, transformed the casting from one requiring a skilled man to produce to one which could be manufactured speedily on a moulding machine, with a lower grade labour. By making the outside plain it was now possible to employ a side riser or shrink bob and mould direct as shown in Fig. 3.



Figs. 1, 2 and 3 (top to bottom).—Original feeding and modification to design to simplify moulding

Fig. 4 illustrates another example of modification facilitating production. It is a scrap view of a portion of a casing casting containing a mechanism that worked in an oil bath. In producing this casting it was necessary to mould in two boxes with a mould joint through B. To accomplish this with the design shown in Fig. 4 necessitated making a core to relieve the pocket which was occasioned by the bottom wall of the casting being on a slope to facilitate draining, and the two side walls being brought down to within a ¼ in. of the bottom. Not only was this design costly in core makers time and subsequent processes, but it also increased the waster risk, as the core was liable to shift. After pointing out the difficulty to the designer, the foundry was able to get the concession of leaving off the vertical ribs D and thus making a straight forward moulding job shown in Fig. 5, which effected considerable saving—T. R. Harris.



Figs. 4 (above) and 5 (below).—A design modification which removed the necessity for a core in the base of the casting

Safe Storage of Abrasive Wheels

From a storage point of view an abrasive wheel is like a piece of glass and must be handled accordingly. There is a risk of breakage inherent in every abrasive wheel, however carefully manufactured. Although the utmost care is taken in making them, such wheels may have slight defects invisible to the eye or they may develop faults during transit and after they have left the manufacturer's hands.

It is therefore essential that all who use, store and handle abrasive wheels should have a good and careful system for doing so. Abrasive wheels are made in great variety to meet the many differing requirements of use. The first thing to do on receipt of a new wheel is to check its markings to ensure that it conforms to specification. British Standard Specification 1814/1952 is generally used by manufacturers for marking wheels and those responsible for receipt of stores should be familiar with the markings used. This system covers variations in abrasive grain size, hardness and type of bonding.

On unpacking a consignment of wheels, care should be taken in using any tools because a tool carelessly handled might damage the wheels before they are even unpacked.

Testing and examination

It is important that defective wheels should not be put into store at all so a careful inspection for visible flaws should be carried out first of all. If a defective wheel is found it should be rejected; in cases of doubt the manufacturer should be informed. As some defects cannot be detected by the eye this visual test should be supplemented by a simple test. The individual wheels should be suspended and lightly tapped; if the resultant sound suggests that the wheel is cracked it should be rejected. A little experience will soon enable the man doing this test to distinguish between sound and faulty wheels.

But it should be remembered that organically bonded wheels do not have the same clear metallic ring as vitrified wheels.

In carrying out this test, care must be used not to cause any damage. In the case of small wheels the handle of a screwdriver is suitable for tapping with; but for larger wheels a small wooden mallet is better.

Safe handling

The essentially fragile nature of abrasive wheels requires that handling throughout should be done with understanding and care. The wheels must not be damaged or chipped by rough handling, being dropped or bumped or by being allowed to strike against any hard object or surface. Unless absolutely unavoidable on account perhaps of large size, they should not be rolled along. In the exceptional cases where rolling cannot be avoided, a soft resilient surface should be put down for the wheel to be rolled over. Heavy linoleum has been found useful for this purpose; by using two pieces, one can be removed and placed in front of the other until the place of storage has been reached.

Where possible the wheels should be transported by hand but in other cases trucks or suitable special conveying mechanisms may be used. Such trucks or conveyors should be padded by linoleum or other suitable material. The wheels should be stacked in the trucks with care to ensure that they do not topple over during movement or during loading or unloading. Heavy castings, tools or other articles should not be placed on top of the wheels during transit—or indeed at any time.

Safe storeplace

A suitable storeplace should be allotted for abrasive wheels. It should be planned with special reference to the number and types of wheels expected to be kept. It is not good enough to allot a certain space in the tool stores and hope that safe storage will then look after itself.

Suitable racks will be needed of material, size and shape as required by the particular wheels to be stored. A dry place should be selected but attention should be paid to the location of steam pipes because certain wheels such as rubber and shellac types should be kept away from too much heat.

Some wheels such as taper-sided wheels should be supported on edge or by a central support, whereas resinoid, rubber and shellac types should be laid flat on horizontal surfaces. Where wheels are placed on edge the form of support should be such as to prevent rolling. Racks need a sufficient number of well-dimensioned partitions to prevent wheels falling over. Cylindrical wheels and large straight cup wheels should be stacked on their flat side with corrugated cardboard or other suitable separating material between them. In certain cases such wheels may alternatively be stored in open racks like the larger wheels. In all cases the manufacturer's instructions or advice should be followed even if if they conflict with the general principles outlined here. The manufacturer is as keen as the user to ensure correct storage for the wheels.

In general, wheels should be stored on edge in the racks although very small wheels are sometimes kept in a box or drawer suitably partitioned.

The system of storage

The racks should be so designed that wheels can be put into and removed from their places without disturbing other wheels. All places should be within easy reach and be properly and legibly marked so that location of a particular wheel will present no difficulty.

The overall system of storage needs to be planned to take account of the variables of wheel size, bonding, grade and other matters. By having all places open to inspection it is possible to maintain a constant inventory of wheels in store. Dead stock should be ruthlessly weeded out—again for production and efficiency as well as safety reasons.

Records are necessary but should not be difficult to keep if the storage plan here described is used. The whole store and the storage system should be properly supervised as in the case of cutting tools. Abrasive wheels are valuable stock and they merit good control and storage.

—V. A. Broadhurst, B.A.

Factory floor badly pitted by the action of oil and traffic, and the same floor after resurfacing with CIBA Araldite epoxy resin

Resin for Floor Surfacing

The accompanying photographs show part of a workshop floor at a factory of Johnson, Matthey & Co. Limited, before and after laying an Araldite epoxy resin surface. The floor is subject to oil saturation and also to a constant flow of iron-wheeled traffic. These factors soon caused the concrete to become badly pitted, as can be seen in the photograph taken before the new floor was put down. So that production in the workshop could continue as far as possible without interruption, the Araldite was laid to a depth of $\frac{1}{4}$ in. in small areas by moving groups of machinery at a time. Johnson Matthey cadmium pigment was incorporated in the Araldite mixture in order to provide a coloured finish. As this is a suspended floor on the second storey of the building, the use of Araldite saved a large sum of money as relaying concrete would have necessitated the removal of entire bays.

Nuclear Research and Power Reactors in Euratom Countries

Continuing the review begun in last month's issue

By J. R. FINNIECOME, M.Eng., M.I.C.E., M.I.Mech.E., F.Inst.F., Consulting Engineer

1.2 **European Atomic Energy Community (Euratom)**

The European Coal and Steel Community (E.C.S.C.) was proposed on May 9, 1950, and came into force in April, 1951. It consists of Belgium, The Netherlands, Luxembourg, France, West Germany and Italy. On June 1 of the latter year the Foreign Ministers of the six nations met at Messina to consider a proposal by the Benelux governments to form the European Atomic Energy Community, known as "Euratom". Its ultimate aim was to ensure a closer economic intregration of Europe and these countries represent the "European Common Market". The final agreement was signed in Rome on March 25, 1957, and thus Euratom came into force officially on January 1, 1958, with its headquarters in Brussels at 23 Rue Belliard.

The primary object of Euratom is to:

Co-ordinate research activities
Facilitate the exchange of research results
Establish facilities for training
Ensure that the shareholders take part in projects that might prove too expensive and rather risky for public and private enterprise
Maintain a voluntary patent pool
Supply information, if need be financial assistance but not direct or control investments
Have an option to buy all non-committed supplies of ore and nuclear fuel from Euratom countries
Supply by lease or sale nuclear materials acquired in or outside the Euratom countries for all genuine purposes of public or private enterprise
Have strict powers of inspection of nuclear plants
Establish a common free market for nuclear materials and equipment for the six countries

1.2.1 **Euratom-United Kingdom Agreement**

This was signed in London on February 4, 1959. It provides for:

(a) Co-operation in nuclear matters
(b) Mutual assistance with atomic energy programme
(c) Supply by United Kingdom of fuel for reactors of U.K. design
(d) Co-operation in the development of measures to provide financial protection against third party liability
(e) Exchange of information
(f) Secondment of experts, periodical meetings between the U.K. and Euratom

1.2.2 **Euratom-U.S. Agreement**

It came into force on February 18, 1959, and at the meeting in April, 1959, the Joint Research and Development Board recommended the following programme:

(a) The study of reactors for testing of fuel elements
(b) Manufacture of the fuel elements from the point of view of exploring improved techniques and the causes of corrosion of the materials for cans
(c) The chemistry, metallurgy and behaviour of the materials
(d) Research on moderators
(e) Technology of reactor elements
(f) Heat transfer
(g) Treatment and manipulation of irradiated fuel
(h) Problems of waste

According to the terms of the Agreement for Co-operation between U.S. and Euratom, the research and development programme is expected to be for a period of ten years. The contribution of each party is to be about 50 million dollars (£17 million) over the first five years. The main objective is to install in the Euratom countries in the next four to six years, reactors of U.S. design representing a total electric generating capacity of about 1000 MW.

The total capital cost of the nuclear power stations to be constructed in accordance with this programme was estimated not to exceed 350 million dollars (£127 million), therefore 350 dollars per kW (£127/kW). These values agree remarkably well, for a 200 MW (electric) nuclear power station, with those presented by the author in Fig. 2, published in MECHANICAL WORLD, December, 1958, page 535. It is of interest to add that the above total capital cost was to be financed as follows:

(a) Approximately 225 million dollars to be provided by the participant utilities and other European sources of capital, such financing to be arranged with the appropriate assistance of Euratom, and
(b) up to 125 million dollars to be provided by the United States to Euratom in the form of a long-term credit on the terms and the conditions to be agreed, such funds to be re-lent by Euratom for the construction of facilities under this programme.

It was planned to place the contracts for these four to six nuclear power stations for Euratom countries early in 1959 and to have them commissioned by 1963. However,

Table XI

	Country	Number of shares	Percentage	Capital (£)
1	Austria	20	5·0	357,000
2	Belgium	44	11·0	785,400
3	Denmark	22	5·5	393,700
4	France	68	17·0	1,213,800
5	Germany (West)	68	17·0	1,213,800
6	Italy	44	11·0	785,400
7	Netherlands	30	7·5	535,500
8	Norway	20	5·0	357,000
9	Sweden	32	8·0	571,200
10	Switzerland	30	7·5	535,500
11	Portugal	6	1·5	107,100
12	Turkey	16	4·0	285,600
	Total	400	100·0	£7,140,000

so far only one electric supply company of the Euratom countries has taken advantage of placing a contract for a nuclear power station under the Euratom-U.S. Agreement. It is the Societa Elettronucleare Nazionale (S.E.N.N.), Italy, and the electrical output of the station is to be 150MW. The plant, which consists of a double cycle boiling light water reactor, was ordered from the International General Electric Company, U.S.A., in February, 1959. The power station is located at Punta Fiume, North Italy, and is to be in operation in 1963. The U.S. manufacturers of nuclear power reactors are apparently disappointed that the response to their recommended power building programme has been so poor. Unfortunately, Euratom has so far not been able to convince the power supply companies of her member countries of the desirability of constructing more nuclear power stations to the U.S. Agreement.

On December 23, 1958, U.S.A.E.C. and Euratom issued jointly an invitation to the various countries concerned to submit their research and development programmes. The result of this first request exceeded all expectations, for 375 proposals were sent in, 219 came from European countries and 73 from U.S. and 83 represented projects. They can be classified into the following major groups:

	Group	Number of proposals
(a)	Fuel cycle	117
(b)	Reactor technique	88
(c)	New reactor concepts	14
(d)	Research and development	20
(e)	General studies	4
(f)	Preliminary unclassified proposal	132
	Total	375

The total work supported by the Joint Research and Development Board represents 1·65 million dollars (£600,000), of this 880,000 dollars in the U.S. (£320,000).

1.2.3 Euratom-Canada Agreement

This was signed on October 6, 1959, and the major terms are:

(a) The financial basis will be a 10 million dollar (£3·6 million) budget, contributed half and half by Euratom and Atomic Energy of Canada Limited (A.E.C.L.). It is for co-operation for the first five years.

(b) Exchange of information on research, development, equipment design and its uses, health and safety

Table XII

Country or groups of countries	%
United Kingdom	43·40
Euratom	43·40
Austria	1·85
Denmark	2·00
Norway	1·65
Sweden	4·40
Switzerland	3·30
Total	100·00

Table XV

Organization	Number of Members
O.E.E.C.	17
E.C.S.C.	6
C.E.R.N.	13
Euratom	6
Eurochemic	12
E.N.E.A.	16
I.A.E.A.	70
E.F.T.A.	7
United Nations	82

Table XIII

Principal Members' Contributions for 1959

	Member	Percentage
1	Austria	0·40
2	Belgium	1·21
3	Denmark	0·56
4	France	5·94
5	Federal Republic of Germany	4·95
6	Greece	0·21
7	Iceland	0·04
8	Ireland (Not a member of I.A.E.A.)	nil.
9	Italy	2·09
10	Luxembourg	0·05
11	Netherlands	0·94
12	Norway	0·45
13	Portugal	0·19
14	Sweden	1·29
15	Switzerland	0·90
16	Turkey	0·55
17	United Kingdom	7·22
18	United States	32·51
19	Canada	2·89
20	Australia	1·66
21	U.S.S.R.	12·64
22	Japan	2·03
23	India	2·28
24	China	4·65
	Total	85·55

Table XIV.—MEMBERS OF EUROPEAN COMMUNITIES AND AGENCIES

1	2	3	4	5	6	7	8	9	10
	Country	O.E.E.C.	E.C.S.C.	C.E.R.N.	Euratom	Eurochemic	E.N.E.A.	I.A.E.A.	E.F.T.A.
1	Austria	M		M		M	M	M	M
2	Belgium	M	M	M	M	M	M	M	
3	Denmark	M		M		M	M	M	M
4	France	M	M	M	M	M	M	M	
5	West Germany	M	M	M	M	M	M	M	
6	Greece	M		M			M	M	
7	Iceland	M					M	M	
8	Ireland	M							
9	Italy	M	M	M	M	M	M	M	
10	Luxembourg	M	M	M			M	M	
11	The Netherlands	M	M	M	M	M	M	M	
12	Norway	M		M		M	M	M	M
13	Portugal	M				M	M	M	M
14	Sweden	M		M		M	M	M	M
15	Switzerland	M		M		M	M	M	M
16	Turkey	M				M	M	M	
17	United Kingdom	M		M	M		M	M	M
18	Spain							M	
19	Yugoslavia			M			O	M	
20	Canada				M		AM	M	
21	United States				M		AM	M	

M—Member AM—Associate Member O—Observer

O.E.E.C. Organization of European Economic Co-operation
E.C.S.C. European Coal and Steel Community
C.E.R.N. Conseil Européen pour la Recherche Nucléaire
Euratom European Atomic Energy Community
Eurochemic European Company for the Chemical Processing of Irradiated Fuels
E.N.E.A. European Nuclear Energy Agency
I.A.E.A. International Atomic Energy Agency
E.F.T.A. European Free Trade Association

(c) The two partners to facilitate the granting of patents

(d) Mutual technical advice and training facilities

(e) Inventions and discoveries are to be shared. However, each partner will retain the patent rights at home.

Canada has also agreements with the United Kingdom, U.S., India, Sweden, Australia and Japan for the exchange of technical information, facilities, equipment and nuclear materials.

1.2.4 **The European company for the chemical processing of irradiated fuels ("Eurochemic").**

As a result of a decision taken by the Council of the Organization of European Economic Co-operation (O.E.E.C.) on July 1, 1956, a study group was formed amongst a number of member countries of the organization, interested in the constitution of a joint undertaking for the chemical processing of irradiated fuels, which was registered under the name of "The European Company for the Chemical Processing of Irradiated Fuels" known as "Eurochemic". The twelve member countries are:

Austria	Germany	Sweden
Belgium	Italy	Switzerland
Denmark	Netherlands	Portugal
France	Norway	Turkey

The main purpose is to build and operate a plant for the chemical treatment of irradiated fuel for the production of plutonium. Such a plant is to be erected at the Nuclear Research Centre at Mol in Belgium. It is expected to treat about 100 tons of natural or slightly enriched uranium annually. The plant is to cost approximately £4·3 million and is scheduled for operation in 1961. The

Table XVI.—ESSENTIAL PARTICULARS OF RESEARCH REACTORS IN BELGIUM, FRANCE AND THE NE

1	2	3	4	5	6	7	8	
		Centre d'Etude de l'Energie Nucléaire (C.E.N.)	Centre d'Etude de l'Energie Nucléaire (C.E.N.)	Commissariat a l'Energie Atomique (C.E.A.)	Commissariat a l'Energie Atomique (C.E.A.)	Commissiarat a l'Energie Atomique (C.E.A.)	Delft Technical University (Ministry of Education)	Rea N
1	Designation	BR–1	BR–2	EL–2	EL–3	Melusine	A–57	HFR
2	Location	Mol near Antwerp (Belgium)	Mol near Antwerp (Belgium)	Saclay Seine et Oise (France)	Saclay Seine et Oise (France)	Grenoble Isere (France)	Delft (Netherlands)	St. Maart near Pette (Netherla
3	Type of reactor	heterogeneous natural uranium graphite moderated, air cooled	heterogeneous enriched uranium light water moderated and cooled	heterogeneous natural uranium heavy water moderated gas cooled	heterogeneous enriched uranium heavy water moderated and cooled	heterogeneous enriched uranium light water moderated and cooled	heterogeneous enriched uranium light water moderated and cooled (tank type)	heterogen enriched light wate and coole
4	Rating of the reactor (thermal) kW	3000/4000	25,000/50,000	2000/2200	15,000	1200	10	20,000
5	Date first critical	11.5.56	end 1959	27.10.52	4.7.57	30.6.58	1957	1.5.59
6	Date on full rating	11.3.57	April, 1960	—	13.4.58	Sept., 58		1.8.59
7	Moderator	graphite	light water	heavy water	heavy water	light water	light water	light wqte
8	Coolant	air	light water	CO_2	heavy water	light water	light water	light wate
9	Fuel							
	a Type	natural uranium	enriched uranium	natural uranium	enriched uranium	enriched uranium	enriched uranium	enriched u
	b Enrichment %	—	90	—	1·4% U235	20% U235	20	90
	c Normal fuel charge (kg)	2390	3·99	22	9·0	4	3·5	4·2
	d Specific rating (kW/kg U235)	1·25	12,500	100	1670	300	2·85	4760
	e Expected average burn up before reprocessing	2000MWD/ton	30%	250MWD/ton	2400MWD/ton	10%	20	20
10	Fuel element							
	a Type	rods	tubes	round bars	tubes	plates	curved plates	curved pla
	b Fuel alloy or composition	natural uranium	90% enriched U–Al alloy containing 20 to 25% (wt) uranium		1·58 molybdenum	45% uranium 52 wt% aluminium 3 wt% silicon	14·8 gm/plate	U–Al allo
	c Cladding thickness (mm)	1·0	0·38	1·0	1·0	0·7	0·41	0·41
	d Cladding material	aluminium	aluminium	magnesium	aluminium	aluminium	aluminium	aluminiur
	e Type of subassembly	23 element per channel	concentric tubes	ver.ically hung bars	vertically hung bars	parallel plates	parallel plates (MTR type)	parallel pl (MTR typ
	f Number of fuel elements per sub-assembly	—	4 to 6	4 in line	4 in line	12	12 plates	19 plates
	g Number of subassemblies	—	16	135	99	25	18	35
	h Total number of fuel elements	11,960	64/96	540	396	300	216	665
	i Dimensions of fuel element	2·54 cm dia 20·4 cm long	3·30 to 7·62 cm dia, 76·2 cm long	2·2 cm dia 52·0 cm long	2·2 cm dia 29·0 cm long	7·6 cm × 62·5 cm	2·5 in. × 0·020 in. × 23·6in.	2·622 in. ×
	j Dimensions of subassembly			—	—	7·6 cm × 8·3 cm × 86·3 cm	3·0 in. × 3·16 in. × 34·375 in.	2·966i n. ×
	k Normal life of subassembly	—	9 weeks	1 year	3 months	1 year	27MWD	40 days
11	Core							
	a Overall dimensions	6·84 m dia 6·66 m high	1·1 m dia. i.d. 0·915 m high	2·0 m dia 1·5 m high	1 87 m dia 1·30 m high			22·3 in. lo 23·6 in. hi
12	Core containment vessel							
	a Overall dimensions	—	—	2·0 m dia 3·0 m high	2·56 m dia 4·00 m high		10 ft dia, 22 ft high	5 ft 3 in. d
	b Material	—	body: Al alloy, cover stainless		aluminium		carbon steel tank	aluminiur
	c Mean operating pressure		180 psi		14·7 psia		hydrostatic head	30
	d Mean operating temperature (°F)	176	116·6		140		95	126
13	Primary coolant through core							
	a Type of coolant	air (open circuit)	light water	CO_2	heavy water	light water	light water	light wate
	b Normal flow	62 m³/sec	1760 litres/secs	60 tons/hr	305 kg/sec	55 kg/sec	—	12,000 gp
	c Mean velocity (ft/sec)	263	35·1	492	32·8	1·64	—	14·8
	d Inlet temperature (°F)	140	105·1	122	95	86	—	120
	e Outlet temperature (°F)	283·6	116·9	302	140	149	—	132
	f Rise in temperature (°F)	143·6	11·8	180	45	63	—	12
14	Method of heat dissipation	open circuit	heat exchangers	heat exchanger CO_2/H_2O	heat exchanger D_2O/H_2O	heat exchanger H_2O/H_2O	—	3 heat exc
15	Biological shield	concrete (6·89 ft)	concrete	concrete (7·38 ft)	concrete (8·2 ft)	concrete	concrete	concrete (

authorized capital of Eurochemic is 20 million European Payment Units (E.P.U.) of account, equivalent to 20 million dollars or £7·14 million sterling. The capital is divided into 400 shares each having a nominal value of 50,000 E.P.U. The allotment and the distribution to the twelve member countries is indicated in Table XI. The last column gives the percentage of the total.

The table reveals that both Germany and France are the main shareholders, each contributing 17%, followed by Belgium and Italy, each with 11%. It is of interest to add that the percentage of each is based primarily on the following assumptions:

(a) Equal share of half the capital, which is related to the processing

(b) A share of the other half, which is used for research, development and training, in direct proportion to the national product of the country, allowing for minor adjustments

Eurochemic came into force officially on January 1, 1958, and the first report was published in March, 1959. The 15 directors and their alternates are appointed by the General Assembly, regardless of nationality. In addition a representative of the European Nuclear Energy Agency and also of Euratom takes part in the session of the board of directors in an advisory capacity. Each shareholder or group of shareholders with at least 5% of the company's share is entitled to a seat on the board.

1.2.5 European Nuclear Energy Agency (E.N.E.A.)

At the meeting on June 10, 1955, the Council of Ministers of the Organization of European Economic Co-operation (O.E.E.C.) decided to explore the possibilities of the economic and the financial co-operation of O.E.E.C. countries in the peaceful use of nuclear energy. As the result of the Working Party's examination on the scope, form and method of co-operation it was agreed to

E AND THE NETHERLANDS

	9	10
cal	Reactor Centre Nederland (RCN)	Reactor Centre Nederland (RCN)
ucation)		
	HFR	
	St. Maartenszer near Petten (Netherlands)	Petten (Netherlands)
	heterogeneous	heterogeneous
	enriched uranium	enriched uranium
ted	light water moderated	light water moderated
pe)	and cooled (tank type)	and cooled (tank type)
	20,000	20,000
	1.5.59	March, 1959
	1.8.59	
	light wqter	light water
	light water	light water
	enriched uranium	enriched uranium
	90	90
	4·2	4·2
	4760	4760
	20	20 to 30
	curved plates	curved plates
	U–Al alloy	12% U–Al alloy
	0·41	0·41
	aluminium	aluminium
	parallel plates (MTR type)	parallel plates (MTR type)
	19 plates	19 plates
	35	35
	665	665
23·6in.	2·622 in. × 0·020 in. × 23·375 in.	2·5 in. × 0·020 in. × 23·375 in.
4·375 in.	2·966i n. × 3·068 in. × 36·375i n.	3·033 in. × 3·343 in. × 36·375 in.
	40 days	approx. 2 months
	22·3 in. long, 15·1 in. wide, 23·6 in. high	30 in. long, 28 in. wide, 23·625 in. high
	5 ft 3 in. dia, 16 ft 5 in. high	5 ft 6 in. dia, 15 ft high,
	aluminium	aluminium
	30	30
	126	126
	light water	light water
	12,000 gpm	12,000 gpm
	14·8	14·8
	120	120
	132	132
	12	12
	3 heat exchangers	3 heat exchangers
	concrete (8 ft 10 in. thick)	concrete (8 ft 10 in. thick)

Table XVII.—BELGIUM'S FIRST NUCLEAR POWER STATION AT MOL, NEAR ANTWERP (BR-3)

The plant consists of one reactor, one steam generator, one turbo-generator and the ancillaries.

1	Distinctive features	
	(a) First commercially purchased nuclear power plant in Belgium	
	(b) First nuclear power plant designed and manufactured in the U.S.A. for export.	
2	Owner:	The Centre d'Etudes de l'Energie Nucléaire
3	Designation:	BR–3
4	Location:	Mol near Antwerp
5	Type of reactor:	Pressurized light water moderated and cooled (PWR)
6	Designer and main contractor of the plant:	Westinghouse Electric Corporation (Their subcontractor for architect-engineering services is Gibbs & Hill, Inc., U.S.A.)
7	Ratings and the performance:	
	Reactor heat output	43MW(H)
	Net station output	11·5MW (E)
	Net thermal efficiency of the station	26·77%
8	Fuel	
	Enriched uranium oxide (UO_2) pellets	
	Enrichment of inner half	3·29%
	Enrichment of outer half	4·43%
	Diameter of pellets	0·30 in.
	Length of pellets	0·60 in.
	Diameter of the fuel rod	0·343 in. o.d.
	Length of the fuel rod	56 in.
	Number of fuel rods for each element	110
	Number of fuel elements	32
	Total number of fuel rods	3520
	Arrangement of fuel elements: stacked vertically	
	Thickness of the cladding	0·021 in.
	Material of end plugs: stainless steel	
9	Control rods	
	Material, silver-indium-cadmium	
	Number of control rods	12
	Shape	cruciform
10	Primary coolant	light water
	Number of loops	one
	Pressure of water	2000 psia
	Temperature of water (average)	505° F
	Pressure drop across reactor	50 psi
	Diameter of loop from reactor to steam generator	16 in.
	Total quantity of coolant in circulation	5×10^6 lb/hr
	Temperature of coolant at inlet to the reactor	492° F
11	Secondary circuit of the steam generator:	
	Temperature at inlet to steam generator	325° F
	Temperature at outlet from steam generator	471° F
	Temperature rise	146° F
	Pressure at outlet from steam generator	520 psia
12	Steam turbine plant:	
	Steam cycle	regenerative and saturated
	Net electrical station output	11·5MW
	Single shaft turbine consisting of H.P. and L.P. sections and moisture separator between the two	
	Percentage of moisture removed by the separator	90%
	Steam pressure at turbine stop valve	470 psia
	Steam temperature at turbine stop valve	470° F
	Pressure drop between H.P. outlet and L.P. inlet	5 psi
	Vacuum at L.P. exhaust at 30 in. Hg barometer	2 in. Hg
	Final feed temperatures	325° F
	Number of feed heating stages	3
	Total steam through turbine stop valve	161,000 lb/hr
13	Pressure control system. Pressure is maintained during plant operation by means of a pressurizer	
	Volume of pressurizer	95 cu ft
	Heater capacity	150 kW
14	Year of operation	1960

establish the European Nuclear Energy Agency (E.N.E.A.) which was approved by the O.E.E.C. Council of Ministers on December 20, 1957, and came into force on February 1, 1958. The agency's work is directed by a Committee for Nuclear Energy. However, the major decisions have to be approved by O.E.E.C. Council. The 16 member nations of E.N.E.A. are:

Austria	Iceland	Sweden
Belgium	Italy	Switzerland
Denmark	Luxembourg	Turkey
France	The Netherlands	United Kingdom
West Germany	Norway	
Greece	Portugal	

The United States and Canada participate in all the work of E.N.E.A. as associate members. Yugoslavia is represented by an observer and recently Spain is associated with the activities. The first report was released through the O.E.E.C. in March, 1958.

The projects sponsored by the European Nuclear Energy Agency are:

(a) The boiling heavy water natural uranium reactor "Halden", Norway

(b) The high temperature gas cooled reactor "Dragon" at Winfrith Heath, Dorset

(a) *The reactor "Halden"*

On June 11, 1958, representatives of Austria, Denmark, Euratom (Belgium, France, West Germany, Italy, Luxembourg and the Netherlands) Norway, Sweden, Switzerland and United Kingdom signed an agreement to operate this reactor as a joint project for three years, commencing on January 1, 1958. The United States and Finland are also associated with this reactor project through an agreement with the Institutt for Atomenergi. It is the first boiling heavy water reactor in the world and is located in an excavation in the rock near the paper and pulp factory in Halden, 80 miles south of Oslo. The reactor was designed at the Netherlands-Norwegian Joint Establishment for Nuclear Energy Research, Kjeller, and was built by the Norwegian Institutt for Atomenergi. The fuel was supplied by the United Kingdom Atomic Energy Authority and the heavy water by the United States Atomic Energy Commission. The total cost of the plant, including the first natural uranium fuel and the heavy water, amounted to 3·5 million dollars (£1·26 M). The reactor was started in 1956, went critical on June 29, 1959, and was officially inaugurated by King Olaf V of Norway on October 10, 1959. The heat rating is 20MW and the plant will produce, in the light water circuit, 15 tons of process steam which will eventually be used in the adjacent paper factory.

(b) *The reactor "Dragon"*

This is the second reactor project under the auspices of the European Nuclear Energy Agency of O.E.E.C. The agreement was signed on March 23, 1959, by members of Euratom and the U.K.A.E.A. Austria, Denmark, Norway, Sweden and Switzerland will also participate. This joint project, which is to operate in the first instance for a period of five years, will enable research and development to be taken to the stage of building an experimental power producing reactor. The Dragon is to be installed at the U.K.A.E.A.'s establishment at Winfrith Heath, Dorset, and at the conclusion of the joint programme it will be the property of the authority. The total cost over the period of five years is estimated at £13·6 M. The United Kingdom and the Euratom countries each contribute £4·34 M and the other five nations £1·132 M, which amount to £10 M. The balance of £3·6 M will be paid by the United Kingdom.

The percentage distribution for Euratom and the other countries based on the sum of £10 M mentioned above, is indicated in Table XII.

The Dragon uses enriched uranium and graphite mixed thorium and is cooled by helium. Temperature is 700° to 800° C.

To be concluded

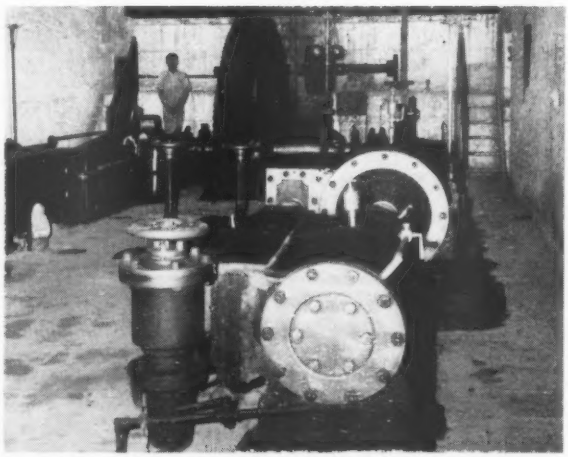
Old Steam Engines

TO THE EDITOR OF MECHANICAL WORLD

Sir,—It is well said in the editorial of December 1959 issue of the MECHANICAL WORLD that early engine houses were built to last a long time because engines of the mature reciprocating age were built to serve industry for a long time. Here are two examples of engines built decades ago, one of which is in working condition and is lying idle, while the other is generating power for the Rai Bahadur Kanhaylal Bhandari mill unit of Nandlal Bhandari Mills Limited at Indore.

The old Cornish boilers have been replaced by Lancashire boilers of Thomas Bailey's make, made in 1898. They have steamed for more than 45 years without any repairs and no ravages of untreated feed water are seen in the interiors.

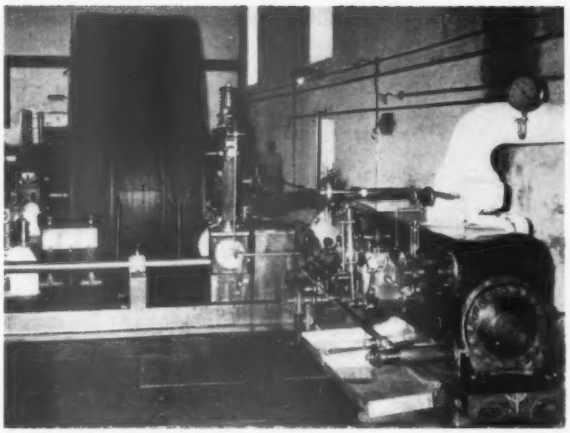
The steam engines too were built to last. They are both in perfect working condition. One is now driving an



The 200 ihp steam engine built by Higginsbottom and Mannock, engineers, Manchester, 1866

alternator to generate motive power and lighting for the mill which has at present installed capacity of 10,000 spindles.

Engine No. 1 (Fig. 1) is a rare piece of machinery and worthy of a place in a museum. It was built by Higginsbottom and Mannock, engineers, Manchester, and is of 200 ihp of the double tandem, compound jet condensing type. It was made in 1866 and worked up to 1939. The steam pressure was 90 psig and the speed 40 rpm. It has two high-pressure cylinders each 13 in. dia, and two low-pressure cylinders 26 in. dia. Piston speed is 420 fpm. The flywheel has toothed segments secured to the rim and there are 138 teeth at 3¾ in. pitch. Power from the flywheel was transmitted to the main driving shaft through a 40-tooth pinion. This engine was stopped due to break-



The 500 ihp steam engine now with Scott and Hodgson's Corliss valve gear, installed in 1883

down of the pinion and was not subsequently worked as the mill reduced the numbers of working spindles and looms.

Engine No. 2 (Fig. 2) is of 500 ihp and was installed in 1883 and was probably originally of the double tandem compound jet condensing type. It was damaged by fire in 1897 and the then management arranged to get it converted into a triple expansion, four cylinder condensing engine to work at a steam pressure of 150 psig. The high-pressure and intermediate cylinders installed at the time of conversion are 16 in. and 26 in. dia respectively and are fitted with Corliss valve gear of Scott Hodgson's design and make. The low-pressure cylinders were retained and are 30 in. dia each and are fitted with slide valves. The engine runs at 40 rpm with a piston speed of 420 fpm.

Power from the flywheel is transmitted to the main driving shaft by three leather belts, two of which are 20 in. wide and the third 31 in.

Since engine No. 1 was closed down twenty years ago, performance data in respect of this engine is not available. However, the cost of power generation by engine No. 2 when compared with the cost of purchased power from the local thermal grid gives a fair idea concerning the performance of old plants designed by engineers in the last century.

During 1959, 403,000 units were generated by the engine at the switch board terminals. Total cost of this generation has amounted to £5080 at the present rate of exchange of Indian currency. This cost includes coal, water, staff, maintenance, repairs and supervision.

If this power had been purchased from the local thermal grid the cost, plus cost of steam for heating, insurance and interest and depreciation on electrical equipment such as transformer, etc., would work out at £4950.

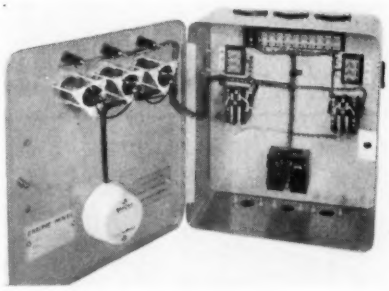
B. M. Bhandari, Chief Executive,
Nandlal Bhandari Mills Limited.

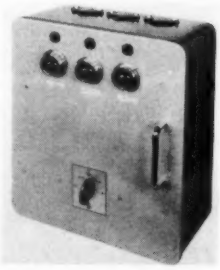
Indore, India.

Diesel Engine Protection

A complete range of diesel engine protection panels, for mounting remote from the engine and engine service switches, is produced by Special Products Department of A.E.I. Radio and Electronic Components Division, 155 Charing Cross Road, London WC2. The panels can be supplied to give immediate visual and audible warning of failure in lubrication and cooling systems and, if required, subsequent shut down.

The range runs from panels having two alarm or two shut-down circuits to types providing either four alarm, four shut-down, or three alarm plus three shut-down circuits, with variants between these extremes. It embraces main panels for use in single engine installations or for the first or main engine in a multi-engine installation; extension units (for all engines except the main one in a multi-engine installation); a panel to indicate overspeed running and to shut down the engine in the event of this occurring; a test circuit for checking the various warning lamps and shut down indicators; and a cancellation circuit for cutting out the audible warning note while a fault is being remedied.





A.E.I. diesel engine protection panels

These units are supplied in the combination necessary to the customer's requirements.

Pre-set Pulley

A new pre-set variable speed pulley which can be set and locked at any pitch circle diameter required has been developed by Industrial Drives Limited, of Ealing, London. Its chief advantage, apart from its reasonable cost, is that it avoids the need to stock a large variety of different sized pulleys.

This new pulley, of simple design, is as easy to install as a conventional V-pulley and it is not difficult to set. It is designed for use with standard V-belts and works with existing standard pulleys and belts, thus obviating the need for expensive modifications.

It consists of two cast iron flanges, one fixed and secured to the motor shaft and the other adjustable on its screw thread. This is positively locked at the precise ratio by a clamping arrangement. The curved flange faces ensure correct groove angle at any pitch circle diameter, thus achieving maximum efficiency for the drive.

The pulleys can be used in conjunction with standard motor slide rails when used as a drive pulley. They can also be used as a pair thus giving an overall variation of 4:1, and they can then be operated on fixed centres.

Testing Small Motors

During the manufacture of car heaters at the Witney factory of S. Smith & Sons (England) Limited a piece of electronic equipment automatically tests the motors, passing or rejecting them and, if rejected, giving the reason, the only human requirement being the operator who places the motors in position, starts the test cycle by footswitch, and finally takes the motors off at the end of their test. The equipment has been evolved in conjunction with Electronic Machine Company Limited, Thornton Heath, Surrey.

The operator presses a footswitch which releases an air-operated clamp, allowing the motor to be placed in the jig. The operator then turns the motor into the testing position, releases the footswitch and the motor is then securely locked in position. On inserting the motor the shaft enters an automatic collett which locks when power is applied and the armature starts to revolve.

The motor is run-up to a predetermined speed under a predetermined load, thus similating operating conditions. On reaching operational speed and load the following tests are automatically carried out:

Voltage requirement: This is tested to ensure that the motor will perform satisfactorily at its nominal voltage, the motor being rejected if outside the pre-set limit.

Current consumed: This must not be high or the motor will overheat and damage the battery or wiring.

Armature balance: This test is carried out to ensure that the motor does not vibrate when running. The plate on which the motor is mounted is floating, so that any vibration will cause the motor plate to vibrate. This vibration is then detected by a magnetic pick-up.

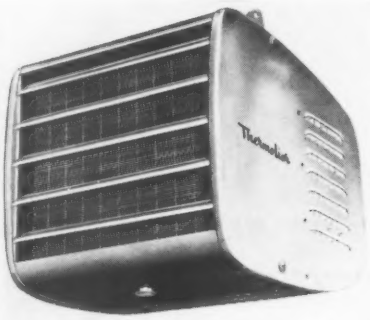
Brush and bearing noise: This must be below certain limits or the motor will be noisy in service.

Insulation: The windings are tested on switch-on to ensure that there are no short circuits.

A timer ends the test and indication is then made by red or green lights if the motor has failed or passed the tests. The levels of voltage, current, speed, armature, brush and bearing noises, are indicated on meters and red lights, the speed of the motor being kept constant by a servo-system driven by a tachometer the output of which is proportional to motor speed. Tachometer input is derived from photocells using reflected light from a black and white segmented disc. This disc is the eddy current brake which is the dynamic load for the motor.

Testing of car heater motors by electronic machine

Motors are loaded alternatively into two jigs, the testing of one taking place whilst reloading and running-up of the other is accomplished. Selection of right or left motor is arranged by footswitch and the total number of motors that have passed the test is displayed on a six-figure counter on the front panel.



UNIT HEATER.—This new Thermolier unit heater introduced by Mather & Platt Limited, Manchester, is designed to fit into almost any background. It is finished in silver grey stove enamelled paint with a hammer finish. Made in five sizes to operate on steam or hot water, the output ranges between 35,000 and 350,000 Btu per hr. A thermostat can be fitted if required and the louvres are individually adjustable

Hydrostatic Tank Contents Gauge

A new pressure bulb type hydrostatic tank contents gauge, introduced by Firth Cleveland Instruments Limited, Stornoway House, Cleveland Row, London SW1, will measure the head of liquid in most types of non-pressurized tank, wherever situated and regardless of size and height. Its indicator can be placed up to 250 ft from the tank to show by a dial and pointer, 4, 6, 8 or 12 in. dia, either the depth of liquid or the tank contents. The gauge is completely self-operative and offers continuous indication.

It is in two units, transmitter and indicator, together with air line and connectors. The tank liquid fills the lower chamber of the transmitter unit to apply a pressure against the lower surface area of a synthetic rubber pressure bulb. This pressure, the hydrostatic head of liquid in the tank, is transmitted through a small bore copper or nylon air line to the indicator. It is necessary to know the density of the fluid in order to calibrate the indicator in depth units and also the tank size and shape if readings are required in volume or mass units. By reducing stiffness in the pressure bulb as much as possible, errors due to change in atmospheric pressure or in the temperature of the air in the sealed system, have been reduced to negligible proportions. The bulb is made of variable thickness and of such a shape that in operation it is similar to a rigid piston of large area sealed by a membrane of low stiffness around its edge.

The gauge is suitable for all liquids compatible with the materials of the bulb and its housing. This is normally of high-grade cast iron, which may be stove-enamelled, hot-tinned, or left in natural finish depending on the liquid being gauged.

To meet varied requirements a choice of six types of installation is available. The transmitter unit, weighing 12 lb and with an overall diameter of $8\frac{3}{4}$ in. can be mounted externally with a short pipe-line entering either the side or bottom of the tank to penetrate above sludge level. When mounted internally it can be suspended from a chain in three methods of installation or alternatively be firmly clamped in the base of the tank. Three of the methods of internal installation allow the transmitter to be placed above sludge level.

The maximum length of air line should only be used if the greater part of it is exposed to atmospheric temperature. The maximum recommended working temperature of the transmitter unit is 65°C.

The gauge can be equipped with additional accessories to provide automatic high or low level alarm indications or automatic control of a pump to maintain the liquid level in the tank between predetermined limits.

Metering Pumps

A new series of highly accurate directly controlled metering pumps for general chemical applications has been introduced by Kontak Manufacturing Company Limited of Grantham, Lincolnshire. Capacities range from 0–1½ up to 180 gph and a number have already been applied to nuclear and general chemical purposes. The new series is an extension to the remotely controlled range of diaphragm pumps, the development of which was initiated by the Atomic Energy Authority at Harwell, in 1953, in conjunction with Kontak Manufacturing Company Limited for handling highly corrosive, and toxic materials with radioactive content.

The pump consists of an hermetically sealed controlled displacement diaphragm pump called a "metering head" together with a motorized reciprocating oil pump, the function of which is to provide a remote hydraulic drive to the metering head: this is known as the "actuating pump". In the case of the remotely controlled pumps for nuclear applications, an additional component, the "regulator", is used to control the metering head displacement. However, with the new series of directly controlled pumps, the regulation control and indication is incorporated in the metering head itself.

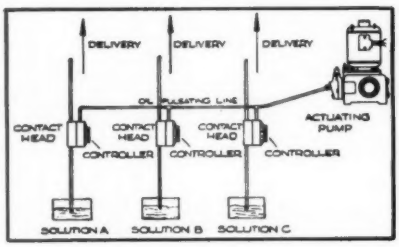
The directly controlled metering head consists of a stainless steel or P.T.F.E. diaphragm unit, the volumetric displacement of which is adjustable by means of a hand operated control knob, and a contact head—a body containing inlet and outlet valves—which carries all the parts coming into contact with the pumped medium. The ball type valves used in the contact head are in tandem so that slurry can be handled.

The reciprocating piston movement of the actuating pump is obtained by means of a circular eccentric cam with roller bearings. On a pressure stroke the metering head diaphragm is displaced to the limit of its travel and a surplus volume of oil is expelled through a relief valve to the oil reservoir.

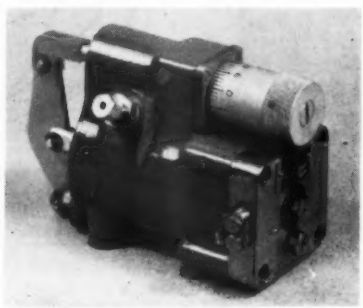
NEW FLANGED FLOW-SIGHTS.—Liquid Systems Limited of Holmethorpe Avenue, Redhill, Surrey, have added flanged versions to their range of flow indicating and control instruments, up to 6 in. nominal bore. The illustration of the Model LS. 150 3 in. angled gravity flow-sight shows two plugged inlets for thermometer, vent or vacuum line connexions as may be required. Model LS. 140 is the straight version. All instruments are made in acid resisting bronze or in cast iron, steel or stainless steel

On a suction stroke the diaphragm is displaced to the limit of its travel and then cavitation occurs in the pump cylinder. An inlet valve then opens to admit oil to the cylinder and this volume of oil is expelled at the next pressure stroke. In this way it is ensured that the diaphragm moves between fixed limits, which means that delivery is a function of diaphragm positioning and the speed of the oil pump only, and is therefore independent of installation conditions.

As the diaphragms are separated by a buffer chamber, the contents of this chamber determine the stroke of the diaphragm. The content can be varied by means of the hand operated regulator. Although water is normally used as the diaphragm buffer liquid, silicone liquid may be used where high temperatures are likely to be encountered.



Typical unit installation. The diagram illustrates how multiple installations may be operated with independent control for proportionate mixing from one actuating pump (shown below)



The actuating pump which provides the timed pulsating hydraulic drive, using vacuum oil as a medium, is connected to the metering head by means of a rigid pipe which may be branched to supply the drive to a number of metering heads.

Extreme accuracy is one of the major advantages of the pump. The manufacturers claim an accuracy of less than ± 2% within specified conditions and ± ½% on repeatability under fixed conditions. Among other advantages claimed for the remote actuated pump are its ability to handle abrasive slurries and to run "stalled" indefinitely without damage, when operating against a blocked system. A complete hermetic seal between the pumped medium and ambient atmosphere, or actuating and control liquid, ensures freedom from contamination in either direction. Of particular importance is that multiple installations may also be operated with independent control for proportionate mixing from one actuating pump. Unskilled personnel may easily demount and refit the contact head without stopping the actuating part. The pump, which is self-priming, not only handles highly corrosive and toxic materials, but also gives an appreciable suction lift and delivery pressure.

Pumps with 2 ml and 15 ml per stroke displacement are available at present, but other types providing 5 litres a minute and up to 20 litres a minute are already under consideration. The 2 ml micro-pump has a maximum delivery pressure of approx. 750 psi, and a maximum suction lift of 15 ft at 27 strokes/minute.

Chaintabs

Chains and slings have to be marked with their safe working load and carry an identification number from a test certificate. To facilitate compliance with these requirements, Arthur Taylor & Co., 6 Grafton Road, Sparkbrook, Birmingham 11, have produced a steel tab which can be readily fastened to chain or rope eye very simply and securely with the aid of a hammer. These "Chaintabs" are made in three sizes with 2⅜ in., 1⅛ in., and ⅞ in. hole.

Earth Leakage and Earth Fault Protection—VI

Protection by Fuses and Over-load Circuit Breakers

By J. L. WATTS

Earth-leakage and earth-fault current will only be cut off by a fuse if it results in the current through the fuse exceeding its fusing value. Such fault current will only be cut off by a circuit-breaker if it causes the current through the excess-current elements to exceed the value at which they are set to operate, and if the breaker is free to trip. When a circuit is protected by a fuse of the same current rating as the circuit, with a fusing factor or two, the fuse may permit an earth-fault current up to twice the current rating of the circuit to flow, if the circuit is otherwise unloaded. A breaker set to operate at 25% above the current rating of the circuit may permit an earth-fault current equal to $1\frac{1}{4}$ times the rating of the circuit to flow, on no-load. If the circuit is loaded, the earth-fault currents permitted will be reduced but may still be quite appreciable.

This is one serious disadvantage of earth-fault protection by fuses or overload releases, or other devices which operate only on high leakage currents. It seems likely that there may be appreciable unsuspected earth-leakage currents on many installations. Fuses and over-load circuit-breakers may, in fact, permit earth-leakage currents which are sufficiently large to introduce a risk of fire if the earth-continuity conductors are too small, have a high-resistance connexion, or if leakage to earth occurs through some unintended path, such as a gas pipe. It is, therefore, very desirable that the minimum practicable sizes of fuses should be used, over-current trips set at the minimum practicable value, breakers checked periodically to ensure they are free to trip, earthing connexions inspected from time to time, and periodical tests made of the insulation resistance and of the earthing circuits.

Impedance of the earth-fault loop

The duration of earth-fault current should be limited, since a prolonged earth-fault current may create more serious risks of fire or shock than would a momentary higher current. Where earth-leakage protection is by fuses or overload circuit-breakers it is highly desirable that the impedance of the earth-fault loop be low enough to ensure that earth-fault current will be cut off quickly. The maximum impedance of the earth-fault loop which will allow these protective devices to cut off the current ultimately, in the event of a fault on a phase conductor, is equal to (phase-to-neutral voltage of the supply) divided by (minimum melting current of the fuse, or operating current of the overload circuit-breaker).

Where the exposed metalwork on a consumer's installation is connected to an isolated earth electrode, as at H in Fig. 1, the earth-fault loop comprises the following items: one phase C of the supply plant, the phase conductor D from the supply plant to the faulty apparatus, the impedance E of the apparatus between the phase conductor and the point of fault, possibly some resistance of the fault, the earth-continuity conductor F from the faulty apparatus to the consumer's earthing terminal L, the consumer's earthing lead G to the earth electrode, the consumer's earth electrode H, the general mass of earth I, the neutral-point earthing electrode J, and the neutral-point earthing lead K.

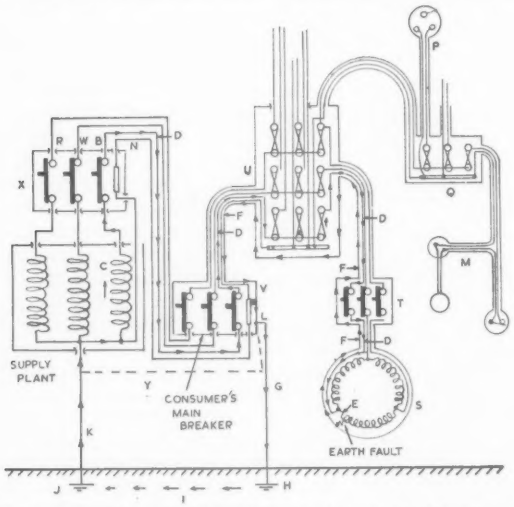


Fig. 1.—Section of a consumer's installation showing path of earth-fault current

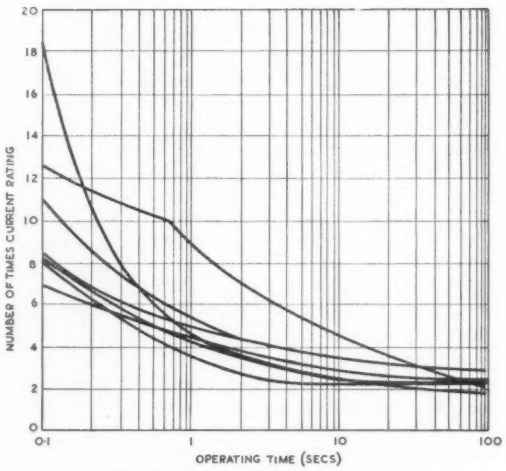


Fig. 2.—Time-current characteristics of typical fuses

The I.E.E. Regulations require that, where fuses or overload circuit-breaker are relied upon to protect against earth faults, the impedance of the earth-fault loop shall be sufficiently low that, in the event of an earth fault of negligible impedance from a phase or non-earthed conductor to adjacent exposed metal, i.e., if the item E is zero, a current equal to three times the current rating of the fuse, or 1½ times the setting of the overload circuit-breaker, can flow so that the faulty circuit is made dead.

Column 4 of Table I gives the maximum permissible earth-fault loop impedance which will satisfy the I.E.E. requirements in the case of circuits operating at 240 volts between phase and neutral, corresponding to 415 volts between phases of a three-phase supply. The maximum permissible impedance is proportional to the phase-to-neutral voltage of the supply; and is related to the circuit protection rather than to the current rating of the circuit.

It is possible that a comparatively high earth-fault loop impedance to metalwork on the lighting circuit M, or the socket-outlet circuit P, may allow the fairly small fuses in the single-pole and neutral distribution fuse box Q to cut off earth-fault current on these circuits. However, the fault-loop impedance to the motor S must be low enough to operate the overload releases in the starter T, and preferably the fuse in the distribution box U. The impedance of the earth-fault loop to the casing of the distribution fuse box U should be sufficiently low to cause operation of the excess-current releases in the main breaker V. The lowest fault-loop impedance is required to the case of the breaker V, which is protected only by the excess-current releases in the breaker X controlling the supply to this consumer.

Time-current characteristics of fuses and excess-current releases

If the neutral-point earthing electrode has a low impedance an earth fault on a phase conductor may cause the exposed metalwork of the conductor, and metalwork bonded to it, to become 'alive' at phase-to-neutral voltage to earth. After consideration of the physical effects of current it was suggested that, for protection against risk of serious shock under normal conditions, earth faults which caused exposed metalwork to reach 240 volts to earth should be cut off in no more than about one second. Fig. 2 shows the time-current characteristics of various fuses, from which it is seen that up to about nine times the rated current must pass through a fuse to cause this to melt in one second. On an unloaded circuit earth-fault current of three times the rated current of the fuse may be cut off by some fuses in about two seconds, but other fuses may not operate for about 30 sec.

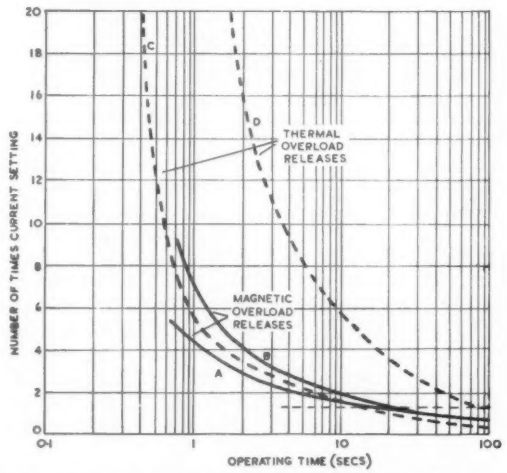


Fig. 3.—Time-current characteristics of typical thermal overload releases, and magnetic overload releases set at 25% overload

The curves A and B in Fig. 3 refer to two magnetic overload releases having time-lag dashpots. One release requires seven times the current setting to trip the breaker in one second. On an unloaded circuit earth-fault current of 1½ times the setting of this overload circuit-breaker may not cause the breaker to trip for about 20 sec or so. The time lag of a magnetic over current-release may vary considerably, depending on the adjustment of the time-lags, the grade of oil in the dashpots, and the temperature.

Curves C and D in Fig. 3 refer to two types of thermal overload release, one of which requires 1½ times the current setting to cause operation in about 1½ min. Whilst a thermal overload release in a motor starter may provide good protection against overheating of the motor and starter-to-motor cables in the event of an earth fault, it is desirable that the earth-fault loop impedance to the motor be low enough to melt the sub-circuit fuses, or operate the sub-circuit breaker, quickly instead of relying on thermal overload releases for protection against the risk of shock due to an earth fault. In any case the sub-circuit fuses, or breaker, must protect the starter and the cables feeding the starter. It is admitted, however, that a circuit-breaker interrupts all the supply phases, thus avoiding risk of damage to a motor due to "single-phasing", which might result from melting of a fuse in the faulty phase only.

The insulation of some apparatus, such as heating elements of cookers, may allow a minute leakage current to flow. This will involve no risk if the metalwork is properly earthed. Earth-fault current on a loaded circuit is interrupted rather more rapidly than one on an unloaded circuit, due to the load current, as well as the fault current, passing through the excess-current device; and possibly due to some preheating of the excess-current element. However, if an earth fault occurs at some point other than a phase conductor, the impedance of the apparatus between the phase conductor and point of fault (shown at E in Fig. 1) will reduce the voltage on the exposed metalwork. It will also reduce the fault current and thus increase the time required to cut off the current. With earth-fault loop impedances no greater than those given in Table I it would then be possible for the exposed metalwork to remain "alive" indefinitely at up to about half the phase-to-neutral voltage in some circumstances.

Effect of reduced earth-fault loop impedance

Whilst a direct earthing system complying with the minimum I.E.E. requirements will afford good protection against the risk of fire due to earth faults, it would seem that if a fuse or overload circuit-breaker is to operate with sufficient rapidity to avoid any risk of serious shock, it is desirable that the impedance of the earth-fault loop be limited to about one-third of the values given in Column 4 of Table I. If such low impedances can be obtained, nine times the rated current of the fuse would flow in the event of an earth fault of negligible impedance from a phase conductor to adjacent exposed metal, so the current would be cut off in about a second. Four-and-a-half times the tripping current of an overload circuit-breaker,

set at twice the rated current of the circuit, would flow due to a similar earth fault, so the breaker would trip within about 2 sec. If the breaker was set at 125% of rated current, as is preferable, it would trip more rapidly, probably in about a second.

With fault-loop impedance values one third of those given in Column 4 of Table I, twice the rated current of the fuse would flow through any earth fault which caused the voltage between the exposed metalwork and earth to reach a value of (Phase-to-neutral voltage) /4·5, even if there was appreciable resistance at the fault itself, and irrespective of whether the fault occurred on a phase conductor or at some other point. On a supply at 240 volts between phase and neutral the fuse would melt within a couple of minutes or so, even on no load, if any earth fault caused the metalwork to reach 53·5 volts to earth, with more rapid cut-off on load; assuming negligible resistance at the neutral-point earthing electrode. Any such fault would also cause an overload circuit-breaker to trip within a couple of minutes or so, even if set at twice the rated current of the circuit.

The effect of a resistance (R ohms) at the neutral-point earthing electrode is that, during the passage of an earth-fault current of I amp, a voltage, equal to $I \times R$ volt, would exist between the neutral point of the system and the general mass of earth. With earth-fault loop impedances one third of the values given in Column 4 of Table I, however, any earth-fault current would be cut off within a couple of minutes if it caused the vectorial sum of the voltage between the exposed metal and earth, and that between the neutral point and earth, to reach 53·5 volts. Thus the fault current would then be cut off if the exposed metalwork was sustained at less than 53·5 volts to earth; or if the neutral point was sustained at 53·5 volts to earth (even if all the fault-loop impedance was at the earthing point of the neutral); with more rapid cut-off on load or if the metalwork or neutral reached higher voltages to earth.

Limitation of voltage between exposed metal and earth

In practice it is usually quite a difficult matter to obtain such low earth-fault loop impedances, particularly if there is appreciable resistance at the neutral-point electrode. However, in these circumstances it may be practicable to limit the possible voltage between the exposed metalwork and earth by limiting the impedance of part of the earth-fault loop. It may be noted that the I.E.E. Regulations state the desirability of limiting the maximum sustained voltage between the exposed metal required to be earthed and the consumer's earth terminal to 40 volts. These Regulations state that the impedance of the consumer's earth-continuity conductor should not normally exceed one ohm, whilst lower values are required where circuits of high current-rating are in use at low or medium voltage.

If the impedance of the consumer's earth-continuity conductor, earthing lead and earth electrode (items F, G and H in Fig. 1) can be limited to the values given in Column 4 of Table II, twice the rated current of the fuse, or current equal to the setting of the overload circuit-breaker, must flow in the case of any earth fault causing the exposed metalwork to reach 40 volts to earth; the fault current would then be cut off within a couple of minutes or so, even on no load.

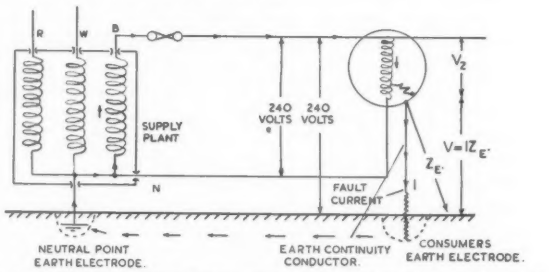


Fig. 4.—Limitation of voltage between exposed metalwork and the general mass of earth by limiting the impedance of the earthing circuit between these points

If an earth fault caused the metalwork to reach a higher voltage to earth, the current would be cut off more rapidly. For instance, if the neutral-point earth electrode had a negligible resistance, and an earth fault on a phase conductor thus caused the exposed metalwork to reach almost 240 volts to earth, 12 times the rated current of the fuse would flow, to cut off the current within a second. Six times the current setting of an overload circuit-breaker set at twice the rated current would flow, and the current would be cut off in about a second, with quicker cut-off if the breaker was set at a lower value.

Table I.—MAXIMUM PERMISSIBLE IMPEDANCE OF EARTH-FAULT LOOPS ON CIRCUITS OPERATING AT 240 VOLTS TO NEUTRAL WITH EARTH-FAULT PROTECTION BY FUSES OR CIRCUIT BREAKERS (I.E.E. REGULATIONS)

1 Rating of circuit fuse (amps.)	2 Size of tinned-copper fuse wire (s.w.g.)	3 Over-current setting of circuit-breaker (amps.)	4 Maximum permissible impedance of earth-fault loop (ohms) on a 240 volt circuit
5	35	10	16
10	29	20	8
15	25	30	5·3
20	23	40	4
30	21	60	2·7
40	19	80	2
60	17	120	1·33
80	15	160	1
100	14	200	0·8
125	—	250	0·64
150	—	300	0·53
175	—	350	0·46
200	—	400	0·4
300	—	600	0·27
400	—	800	0·2
500	—	1000	0·16

Table II.—SUGGESTED MAXIMUM IMPEDANCE OF EARTHING BETWEEN EXPOSED METALWORK AND EARTH FOR CIRCUITS PROTECTED BY FUSES OR CIRCUIT-BREAKERS

1 Rating of circuit fuse (amps)	2 Size of tinned-copper fuse wire (s.w.g.)	3 Over-current setting of circuit-breaker (amps)	4 Suggested maximum permissible impedance between exposed metalwork and earth. (ohms)
5	35	10	1
10	29	20	1
15	25	30	1
20	23	40	1
30	21	60	0·67
40	19	80	0·5
60	17	120	0·33
80	15	160	0·25
100	14	200	0·2
125	—	250	0·16
150	—	300	0·13
175	—	350	0·11
200	—	400	0·1
300	—	600	0·07
400	—	800	0·05
500	—	1000	0·04

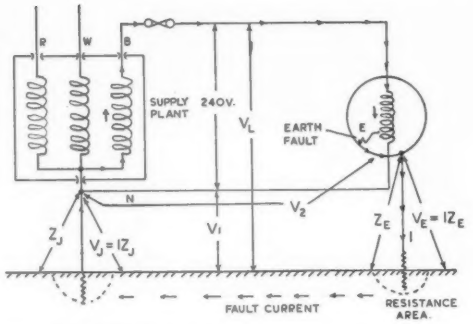


Fig. 5. (above)—Effect of high resistance at neutral point earthing electrode

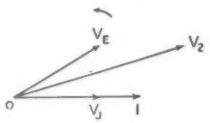


Fig. 6. (right)—Possible phase differences between volt drops

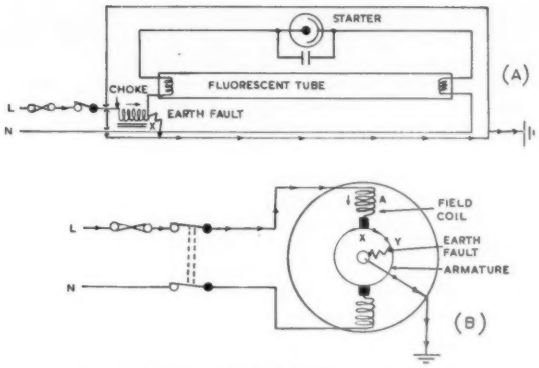


Fig. 7.—Limitation of earth-fault current by circuit components

Fig. 4 indicates the conditions which would then exist if the neutral point-earthing electrode had negligible resistance. In this diagram Z_E is the total impedance of the items F, G and H in Fig. 1, and I is the value of the fault current. Until the fault current was cut off the exposed metalwork would be at V_E volt to earth, where V_E is the product of the earth-fault current permitted by the excess-current protective device, and Z_E.

Effect of resistance of neutral-point earthing electrode

Fig. 5 indicates the conditions if there is an appreciable resistance Z_J at the neutral-point earthing electrode. Unless, or until, the fault current of I amp was cut off the metalwork would be at V_E volt to earth (equal to $I \times Z_E$). There would also be a voltage V_J (equal to $I \times Z_J$) between the neutral point and earth, With the values given in Table II the fault current would be cut off in a couple of minutes or so if any earth fault caused the exposed metalwork to be sustained at 40 volt to earth, with more rapid cut off if the metalwork reached a higher voltage or the faulty circuit was loaded. If the faulty circuit was unloaded earth-fault currents approaching twice the rated current of the fuse, or the setting of the circuit-breaker, and voltages approaching 40 volt on the exposed metalwork, might be allowed to persist.

Since the earth electrode has a negligible reactance the possible volt drop V_J between the neutral point and earth would be in phase with the fault current I, as in Fig. 6. The impedance of the consumer's earth continuity conductor and earthing lead may cause the volt drop V_E between the metalwork and earth to lead the current, as in Fig. 6. Thus the voltage V_2 between the metalwork and the neutral point is likely to be less than the arithmetical sum of V_J and V_E. The voltage V_L between the phase conductor and earth would then differ from the phase-to-neutral voltage due to the volt drop V_J.

Voltage between the neutral point and earth might be transmitted to the exposed metalwork of another consumer, if such metalwork were solidly bonded to the neutral point, Thus, unless the neutral-point earthing electrode has a comparatively low resistance, it is undesirable to bond exposed metalwork solidly to this point, unless the exposed metalwork of all the plant fed from that system is solidly bonded to the neutral point.

Discrimination by fuses and overload circuit-breakers

A useful feature of earth-fault protection by fuses or overload circuit-breakers is that they provide good discrimination. The size of fuses, or overloading setting, can be arranged so that only the faulty circuit is switched off. Their disadvantage is that they have a comparatively long time lag; and are only operative on fairly high fault currents, irrespective of the impedance of the earthing circuit; and, where the exposed metalwork is connected only to an isolated earth electrode, it is often difficult to obtain earthing circuits of sufficiently low impedance to provide proper protection for high-current circuits.

General regulation requirements

Regulations usually only refer in general terms to the important factor of the time required to cut off fault current. The Electricity Regulations of the Factories Acts stress the need for earthing circuits of sufficiently low impedance to operate excess-current devices with an adequate margin to ensure quick cut-off of earth-fault currents. If the fault current is allowed to flow for an appreciable period there is a possibility that this may dry out the ground round the earth electrode; thus increasing its resistance still further.

The maximum of 2 ohm resistance for a consumer's earth electrode permitted by the Quarries (Electricity) Order, 1956 would limit earth-fault current from a phase conductor to 120 amp on a supply at 240 volts between phase and neutral if there was no other impedance in the earth-fault loop; although in practice the earth-fault currents might be reduced by other impedance. However, even with fuses having a fusing factor of 1·25, or overload circuit-breaker set at 125% of the rated current, it is possible that earth-fault currents might not be cut off if they occur on circuits rated at more than about 100 amp. On high-current circuits an earth-electrode resistance of that order might thus allow dangerously high voltages to persist between the exposed metalwork and earth.

In fact on high-current circuits the main limitation of the possible voltage on the exposed metalwork might be the resistance of the neutral-point earthing electrode, or the point at which an earth fault happened to occur. However, it is worth noting that the Quarries (Electricity) Order, 1956, and the Coal and Other Mines (Electricity) Order, 1956, both state that the metalwork requiring earthing shall be connected to earth in such a manner "as will ensure immediate electrical discharge without danger". This appears to limit the maximum earth-electrode resistance of 2 ohm to low-current circuits in some cases.

Solid bonding to the earthed neutral point

In practice it has been found that in some rural areas the resistance of the neutral-point earthing electrode has been of the order of 50 ohm. Very often the low values of earth-fault loop impedance required to ensure rapid cut-off of earth-fault current on high-current circuits, protected only by fuses or overload circuit-breakers, can only be obtained when the exposed metalwork is solidly bonded to the earthed neutral point of the system. The conductor used for this purpose may be the metal sheathing of the supply cable, or a separate conductor. Earth-fault current on a consumer's metal-sheathed plant or conductors then does not have to pass through any earth electrode. In these circumstances the impedance of the earth-fault loop can often be kept quite low.

The maximum voltage which may then persist between the exposed metalwork and earth is then equal to $I \times Z_2$, where I is the maximum fault current permitted by the excess-current protective device, and Z_2 the total impedance of the consumer's earth-continuity conductor and the return conductor to the earthed neutral point. Z_2 can usually be low enough to permit comparatively high earth-fault currents to ensure quick cut-off of the current if an earth fault causes a dangerous voltage on exposed metalwork. Safe conditions will then obtain if Z_2 is no more than the values given in Column 4 of Table II. Some protection against possible risk of interruption of the return conductor to the neutral point is provided by bonding an additional earth electrode on the consumer's premises to the exposed metalwork.

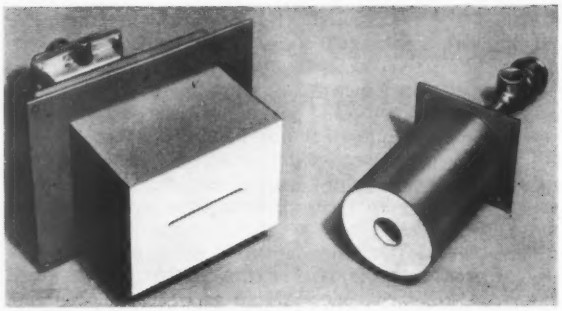
Protection against overheating of appliances due to an earth fault

An earth fault may occur in an appliance at a point where there is sufficient impedance between the phase conductor and the fault to limit the fault current below the operating value of the earth-fault protective device, whilst permitting sufficient fault current to damage the appliance by overheating. In the event of an earth fault at the point X in the fluorescent lamp circuit shown in Fig. 7a, the impedance of the choke coil will most likely limit the fault current below the melting current of the circuit fuse, whilst permitting the choke to carry much more than its rated current.

Similarly the impedance of the field coil A of the series motor shown in Fig. 7b, and the varying amount of the running armature, will limit the fault current due to an earth fault on the armature. Protection against damage and possible fire risk due to such causes may be afforded by means of overload releases set at little more than the rated current, by the use of a protective device which operates on very low earth-leakage current, or by the fitting of a thermal device on the apparatus to break circuit if the temperature of the apparatus becomes excessive.

Tunnel Burners

Utilizing research data made available by the Gas Council's Midland Research Station, Barlow-Whitney Limited, of Dorset Square, London NW1, have designed and introduced their "B-W" tunnel burners which give unusually high rates of heating. The burners are intended for such applications as forge work, billet heating and glass polishing, as well as for installation in boilers, ovens and industrial plants employing the principle of jet recirculation. The burners are of compact design and



Barlow-Whitney air blast tunnel burners. Left, slot discharge. Right, circular discharge

incorporate their own combustion chambers and use air blast injection from a simple centrifugal blower to entrain gas at atmospheric pressure.

Initially, the two standard types shown in the accompanying illustration have been developed.

Series B circular discharge models have metal-cased combustion tunnels for low and medium temperature applications (e.g. to 500°C) and Series C slot discharge models for high temperature applications (e.g. to 1500°C) have refractory cased combustion tunnels suitable for setting in brickwork. Capacities range from 0·5 to 10·0 therms per hour on town's gas (475 Btu. calorific value) when operating on 15 in. w.g. air pressure. Larger and special models and units are made for use with butane and other gases.

New Crane System

A new type of overhead crane system consists of two or more parallel British MonoRail runways, usually attached to convenient roof members, covering the length of the area it is desired to service, and spanned by a bridge attached to trolleys running on the lower flanges of the runways. The bridge which can be up to 200 ft long covers the width of the area, and carries crane hoists of up to five tons capacity attached to trolleys running along the bridge rail. The cranes are fully motorized, and longitudinal movement of a load is achieved by moving the bridge along the runways, while for transverse travel the hoist is driven along the bridge rail.

These new cranes have been specially designed to occupy minimum headroom so that they can be installed in existing buildings where headroom is limited without major structural changes. They are also particularly suitable for installation in large-span buildings of the portal-frame type, where it is often possible to accommodate the greater part of the installation in the roof space above eaves height.

In cases where loads need to be transferred from one bay to another or where pillars intervene, loaded hoists may be moved to bridges in adjacent bays across standard British MonoRail interlocks and transfer sections.

To provide additional flexibility of handling, a number of bridges may be installed on the same runways. In some cases it may be desirable to have two or more separate bridges in the same bay, and where these run parallel to each other they can be interlocked when it is necessary for loads to traverse the full span. The development has been introduced by British MonoRail Limited, Wakefield Road, Brighouse, Yorks.

Constructing the prototype reactor. The picture shows the 5 ft dia reactor tank for heavy water

Training Reactor Gives Maximum Neutrons at Minimum Power

A HIGH-NEUTRON flux, low-power reactor built by the Nuclear Development Corporation of America is the prototype of a proposed line of nuclear training and research reactors. Design of the 25 kW heterogeneous thermal reactor provides for small fuel load with a large experimental region remote from the active core housing enriched fuel elements. Shown in the accompanying picture of the prototype under construction is the 5-ft dia aluminium reactor tank containing heavy water which acts as both moderator and reflector. Additional reflection is provided by a 1-ft thickness of high-purity graphite supplied by Union Carbide Corporation.

In the centre of the tank is an aluminium core assembly with three concentric rings with radial slots to accommodate a maximum of 60 aluminium-clad, uranium-aluminium alloy solid fuel plates. Wide usage is anticipated for a reactor of this type in which the experimental region in the graphite receives practically pure thermal flux, with experiments having negligible effect on the reactivity.

Berkeley No. 2 Reactor Vessel Stressed Relieved

For the second time at the Berkeley Nuclear Power Station a 1000-ton reactor vessel has been successfully stressed relieved in one operation with a 2½ MW heating installation planned, erected and its operation supervised by the Electric Resistance Furnace Company, Limited.

The number two reactor vessel, constructed on site by John Thompson Limited, partner in the main contracting company, A.E.I.-John Thompson Nuclear Energy Company, Limited, was made from sections of 3-in. and 4-in. mild steel plate involving 2500 ft of welds. It contains a large steel diagrid for the support of the nuclear unit.

The stress-relieving operation followed the same general pattern as that which proved successful in dealing with the first reactor vessel. Some 8500 ft of sheathed radiant heaters were erected inside the vessel and were arranged in twenty-four independently controlled zones using twenty-four automatic temperature controllers and four six-point temperature recorders. The vessel was lagged externally with Caposite and Rocksill insulation. Several hundred thermocouples were used in the measurement, control and recording of temperatures.

The vessel was heated to the minimum specified temperature of 575°C in 55½ hr. The complete stress-relieving process involving heating, holding at temperature and cooling to atmospheric temperature was completed in under 14 days.

The reactor vessel has to withstand a working pressure of 125 psig. It was tested at a pressure of 211 psig and has been accepted by Lloyds on behalf of the Central Electricity Generating Board.

Reactor Delay Simulator

The behaviour of a reactor coolant circuit under such conditions as the sudden failure of the circulating pumps is one of the biggest problems in the design and operation of reactors. It is obviously impossible to study these conditions on the reactor itself, but the design information can be obtained from a conventional analogue computer used as a simulator. Simulating variable transport lags is the most difficult part of the problem and E.M.I. Electronics Limited, Hayes, Middlesex, has recently supplied to the Centro di Studi Nucleari di Ispra, Milan—Italy's Harwell—a variable time delay unit which solves this problem more accurately than has been possible before.

Data can be delayed by a continuously variable amount determined by the voltage applied to a "delay control" input, which accurately controls the speed of a loop of magnetic tape passing preset positioned record and replay heads. Total range of delay is 0·1 to 10 sec, available in three pre-selected ranges, and two separate information channels are provided. A precision pulse width modulation recording system, based on units from the company's EMIAC II analogue computer, gives continuously variable delay in conjunction with tape speed, without amplitude distortion and the superior information packing density of magnetic tape is fully utilized.

Lead Bricks for Atomic Shielding

A new lead brick for use in shielding personnel against Gamma, Beta and Alpha rays has been produced by a special 'pressure moulding' technique by British Lead Mills Limited, a member of the Firth Cleveland Group. The bricks are produced in 2-in. and 4-in. thicknesses in the form of standard, corner, top and bottom bricks and also half or even quarter bricks which can be built up into a complete surround by virtue of their interlocking nature, to give the maximum thickness at any point of 2 in. or 4 in. or multiples thereof.

The Weightometer integrates the weight of material carried by conveyor and takes account of belt speed

Conveyor Weigher

A new belt weighing machine introduced by the Merrick Scale Manufacturing Company Limited, Albert Street, Bulwell, Nottingham, will fit horizontal or inclined conveyors having either flat or roughed idlers, and will totalize the weight of material passed over the conveyor.

The heart of the "Weightometer", as the machine is called, is an ingeniously designed mechanical integrator which continuously multiplies two varying quantities, which are, first, the ever-varying load on the conveyor which often is subject to extreme and rapid fluctuation, and, second, a slightly varying belt speed of the conveyor. The speed of any conveyor, whilst usually considered as constant, in reality varies slightly with the load, and in weighing, unless these conditions are taken into consideration, any final results will be erroneous.

Either electronic or pneumatic instrumentation may be used with the machine, and the weight recorder, which shows the weight of material passed over the conveyor, can be at a remote position if required.

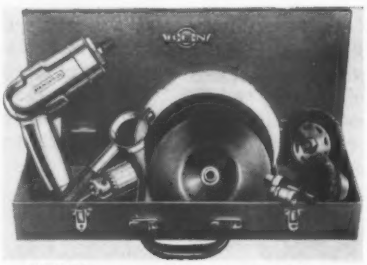
This company is associated with the Merrick Scale Manufacturing Company of Passaic, New Jersey, U.S.A., who have been engaged in the manufacture of this type of equipment since 1911, and who have continuous belt weighing machines in operation which have weighed over 40,000,000 tons of material and continue to give excellent results with unimpaired accuracy of performance.

Pneumatic Tool Pack

A new precision built general utility compressed air tool called the "Powerpac" is now being marketed by B.E.N. Patents Limited, High Wycombe.

The outfit comprises a Powerpac unit with chuck, rubber sanding pad, sanding disc, lambswool pad, cup wire brush, wheel wire brush, "Instantair" coupling and swivel hose connector, together with all necessary tools, all packed in a handy carry-all metal box.

The high-performance air motor has a large reserve of power for operating the heavy duty sanding disc, and smoothing off after repairs to metal work is quickly carried out with a minimum of effort. The sander may also be used effectively in all types of woodworking operations. The lambswool mop, which is easily fitted over the sanding pad, gives a quick final polish to all jobs, whilst the cleaning of rusted surfaces in preparation for painting, welding, etc., is effectively done by the cup or wheel type wire brushes. In addition, the chuck attachment enables a wide variety of additional workshop tools to be used including drills up to $\frac{5}{16}$ in. dia. The price complete is £28. 10s.



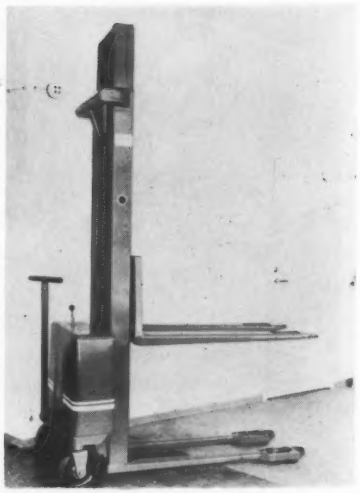
B.E.N. Powerpac outfit in carry-all metal box

Pedestrian/Electric Stacker

Designed and produced in Sweden, the BT SV stackers are pedestrian operated with an electro-hydraulic lift and have a capacity of 1100 lb or 2000 lb at a 24 in. load centre with standard lift heights of 92, 108, 124 or 132 in.

The trucks have a turning radius of only 69 in and an overall length of 63 in. including forks. The unladen weight is less than 900 lb.

All main components such as mast, lifting forks, mast channels, and support legs are one-piece pressings of high-tensile steel. The hydraulic unit incorporates special leak-proof packing. Lifting speed is 33 fpm with the $\frac{1}{2}$-ton model and 16 fpm with the 1-ton model. Masts are of single, telescopic or free lift types.



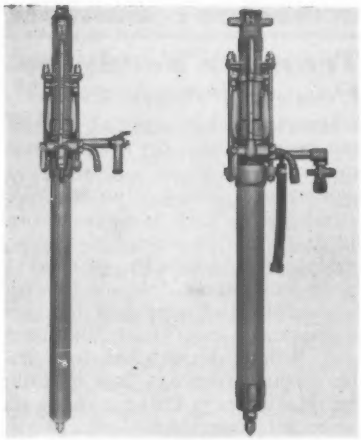
This light Swedish stacker is pedestrian operated with electro-hydraulic lifting gear

Operation is manual or electric from mains or battery. Good manoeuvrability and effortless operation is provided through the fitting of SKF bearings and nylon reinforced Bakelite wheels. The U.K. distributors are Rolatruc Limited, 20 Old Compton Street, London W1.

Holman Silver Three Autostopers

Additions to the range of rock drills and compressed air operated mining equipment manufactured by Holman Brothers Limited, Camborne, Cornwall, are the Silver Three Autostoper and Silver Three double extension Autostoper, both fast and hard hitting machines embodying all the characteristics of the Silver Three Handril which was used in a world tunnelling record advance of 557 ft in one week. More recently, in December 1959, the British tunnelling record for drivages in coal measures was established by the National Coal Board using these machines.

The compact Silver Three Autostoper has been developed from the standard Silver Three Handril, and is integrally mounted to the piston of the feed cylinder and a feed length of 31 in. is provided. A quick and easy positive feed control is provided on the control handle. Lubrication is by line oiler, special provision



Left, single extension; right, double extension

being made to ensure adequate distribution of oil to all working parts. The feed cylinder bore is $2\frac{1}{2}$ in. and the length of the Autostoper is $61\frac{1}{2}$ in. when closed. It weighs 86 lb with a collared steel chuck.

The Silver Three double extension Autostoper was originally developed to suit specific drilling requirements in Australia where local conditions required the use of a stoper which would provide maximum feed with the shortest possible closed length. Its closed length is only 51 in. which enables the operator to work in tight corners and to angle the Autostoper much more than can be done with a single extension machine. It is ideal for working in confined headroom and is well suited to the modern trend of raising in preference to sinking. A feed length of 40 in. is provided which allows a considerable reduction in the number of steels used. The feed is controlled within fine limits by a sensitive twist grip throttle. The double extension Autostoper has a $2\frac{15}{16}$ in. and $2\frac{3}{4}$ in. feed cylinder bores. The length of the stoper is 91 in. when fully extended. It weighs 98 lb with a collared steel chuck.

Industrial Fan Unit

A thermostatically controlled fan heating unit is being marketed by General Trade Equipment Limited, 89–92 Seymour Place, London, W1, at prices starting as low as £22. The open wire spiral-type heating elements operate at black heat under all conditions. The thermostat can be hand-set to cut off the current automatically if overheating occurs. The direct starting motor is fitted with resilient mounted ball-bearings.

As an additional safety precaution the fan units are fitted with suspension straps, deflector louvres and quarter-inch wire mesh screens. A detachable air filter can also be fitted.

The fans are supplied in seven different sizes: the smallest with a 5 kW output and the largest 40 kW.

Thermostatically controlled fan-type heating unit

Nickel Stripper

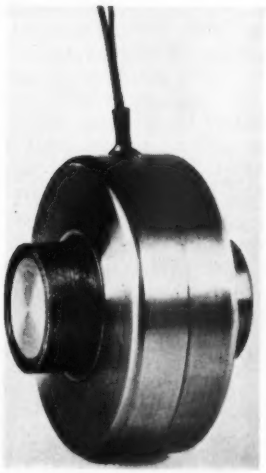
Roto-Finish Limited, 39 Park Street, London W1, are now offering a trial pack of Niplex nickel stripper at 20/-. This consists of two solutions sufficient for making up a one-gallon trial tank. Niplex is a new stripping bath that removes nickel and cadmium without pitting or corroding the base metal, even where it is zinc or copper. The solution is non-electrolytic and can be operated cold, or heated up to 80° C. The stripping rate of a fresh bath at room temperature is approximately 0.00025 in. of nickel per hr. This can be accelerated by heating the Niplex solution up to a maximum of 80° C, and the stripping rate is then increased to 0.003 in. per hr. Using a special dilute bath at boiling temperature the stripping rate can be further increased to 0.006 in.—0·009 in. per hr.

Stationary Field Magnetic Instrument Clutch

Five sizes of a versatile miniature magnetic clutch are being made by Crofts (Engineers) Limited, Bradford. They transmit torques from 4·2 to 420 oz/in. at speeds up to 20,000 rpm and can be utilized as clutch/couplings, clutch/brakes, and duplex clutches, and have wide applications in the instrument and light engineering fields.

In addition to the above there is a range of positive engagement clutches having the same physical dimensions as the standard instrument clutch and capable of giving torques from 14 to 1400 oz/in. at speeds up to 20,000 rpm. These can be used with advantage for indicator drives, and for many applications where a non-slip drive is of importance.

All these clutches feature rapid response characteristics, which emphasize their capability for high frequency instrumentation.



Miniature magnetic clutches for instrument drives. Below, the duplex type

Electro-mechanical Sheet Metal Guillotines

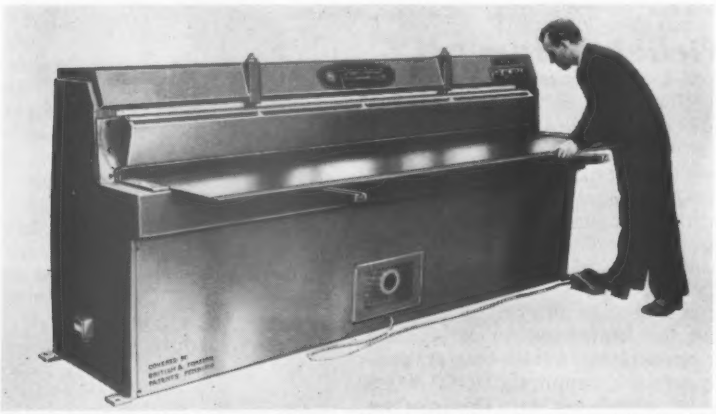
An entirely new range of precision all-steel frame guillotine shearing machines is to be marketed under the registered trade name of "BESCO-TRUECUT" by F. J. Edwards Limited, 359-361 Euston Road, London NW1. The range comprises seven models: 6 and 8 ft machines to shear up to 14 SWG mild steel sheet, and 3, 4, 6, 8 and 10 ft machines to shear plate up to $\frac{1}{8}$ in. thick. Non-ferrous metals and a wide variety of other materials can also be sheared.

A distinctive feature is the adoption of an electrically operated friction clutch and brake, with worm reduction gearbox drive giving precision in the control of the cutting beam. Other features include a main frame of steel plate welded as one unit, precision gauges, dry type low friction wearing strips to the cutting beam slides, and a clean outline with no moving parts outside the frame. The machine is vibrationless and noiseless in contrast to the crash of the old type clutch.

The electrically operated friction clutch is incorporated in the flywheel, is self-adjusting and gives instant engagement, being controlled from a floor-mounted remote foot controller. The machine is arranged for single stroking or continuous action, and is controlled by a conveniently situated selector switch.

The whole of the drive is contained under the bed and is readily accessible for servicing. There is a push-button station mounted at one end of the bridge piece, with stop and start buttons and a "motor running" warning light. A similar light warns from the rear of the machine.

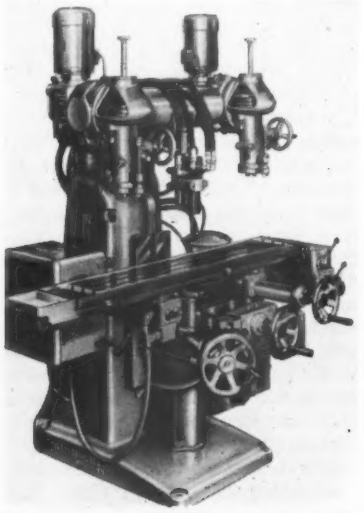
The machine is fitted with a precision dial-type calibrated rear gauge and standard front and side gauges: a side squaring gauge is available. A clear-view "disc spring"-operated, inclined hold-down with anti-slip inserts on the gripping pads is also fitted.



There are seven models in the new range of Besco guillotines, from 3 ft to 10 ft wide and to shear 14 SWG and $\frac{1}{4}$ in. thick material

Transfer Feeds for Power Presses

Transfer feeds for existing presses, and in many cases for existing tools are now available from Press Equipment Limited, Hunters Vale, Birmingham 19. In its simplest form the transfer comprises two pick-up heads, simultaneously gripping a blank component from a location outside the tool area and the processed component from the press tool, lifting to clear locations and die form, traversing, then lowering the blank into the die and the processed component on to an ejection chute. For more than one tool an additional pick-up head is required for each station, so that the component is progressed through each tool until it reaches the ejection point. Pick-up is by either vacuum suction cups or air operated grip-fingers, adjustably mounted on a carriage which has a compounded motion of vertical lift and horizontal traverse.



Fully automatic tracer milling machine—a new addition to the Richmond range

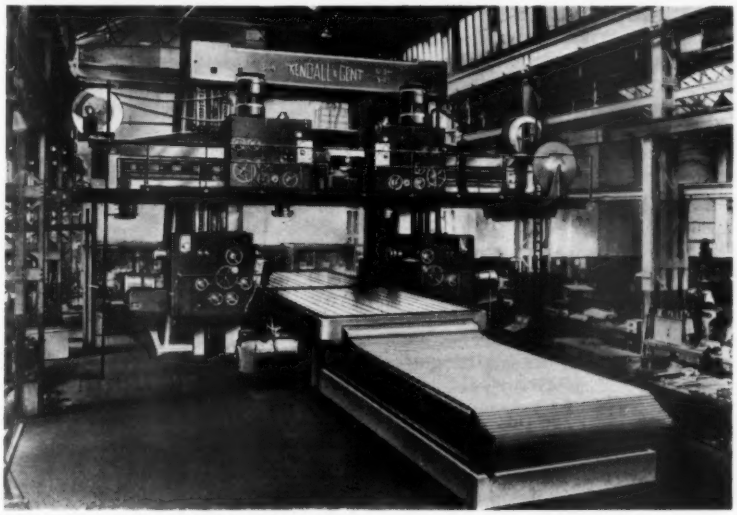
Duplex Turret Miller

Midgley and Sutcliffe Limited, one of the 600 Group of Companies, have added to their well-established "Richmond" range of milling machines a fully automatic hydraulically controlled tracer model. This duplex turret milling machine will accurately duplicate negative or positive dies for such types of work as stamping metal, plastic materials, rubber, glass, etc. The particular sensitivity of the tracer point makes it possible to copy from masters made of plastic, wood, or similar fragile material.

Twin "Hyspeed" heads are used at a fixed centre distance, with the "Hydrotracer" exactly in the centre, permitting both halves of a mould to be machined simultaneously and identically. The moulds and the master to be copied are fixed in a long jig, the moulds under each of the spindles and the master under the stylus of the tracer valve. Vertical movement is hydraulically controlled by a self-contained copying unit of robust and compact construction; fluid pressures from 50 to 500 psi can be accommodated. Longitudinal movement is automatic and reversible; at each reversal, the pick feed to the cross movement operates, giving a completely automatic and continuous cycle.

A separate $\frac{3}{4}$ hp motor provides power for the table feeds, variable through the gearbox at the end of the table to give a range of feeds from $\frac{3}{4}$ in. to 18 in. per min. The cross feed is also variable from 0·004 in. to 0·040 in. at each reversal.

Largest Plano-Miller has Electronic Control



Kendall & Gent 12 ft × 9 ft 6 in. capacity plano-milling machine

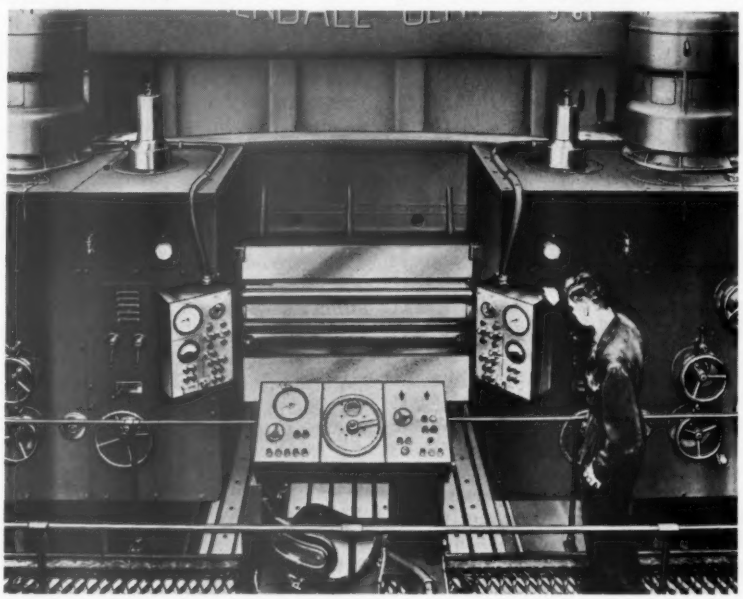
Recently completed at the Manchester works of Kendall & Gent Limited, a 70-ft long, 450-ton plano-milling machine is the largest ever built in Britain and one of the biggest in the world. Designed for machining very large electrical components and steam turbine casings for the nuclear power industry it is being installed at the works of C. A. Parsons & Co. Limited, Newcastle upon Tyne. The machine will take components up to 35 ft 6 in. long, 12 ft wide and 9 ft. 6 in. high. There are four milling heads, each powered by a 100 h.p. motor and capable of operating with face milling cutters up to 3 ft dia. The two side columns are 24 ft high and each weighs 43 tons, the cross-slide carrying the two vertical cutting heads is 45 ft in length and weighs 40 tons.

The table and milling head traverses are controlled electronically to provide an infinitely variable range of feeds. Further electronic equipment is fitted to give the operator the facility of "steering" the cutter, by remote control, round any shape of workpiece. This permits continuous metal removal with a substantial reduction of machining time on any component irrespective of its contour. Steering is effected by movement of a car-type handwheel fitted in each of the three control stations, the path steered by the operator automatically determines the speed and direction of the table and cutter head traverses.

Lubrication is by pump, under pressure, and interlocks are provided to ensure adequate lubrication before heavy mechanism is moved. The traverse drives to the table and the milling heads are electronically controlled, the varying feeder rates being obtained by alterations of the driving motor speeds. The adjustable speed driving equipment was supplied by Lancashire Dynamo Electronic Products Limited.

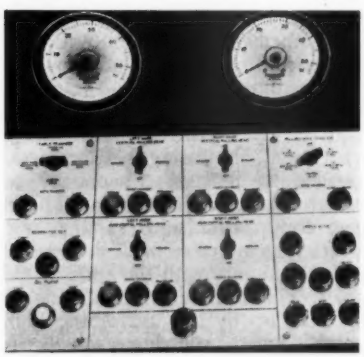
Four control desks and two control panels are provided. The master control desk carries controls for operation of the milling head and table rapid traverse and also the cross-slide traverse. The travelling control desk and also the two desks on the horizontal milling heads carry control for the feed and rapid traverse motions to both table and milling heads. All three of these desks are equipped with steering control handwheels.

When the machine is operating under steering control the table and milling head traverse motors are simultaneously controlled. This allows the direction of travel of the cutter in relation to the work to be steered through 360°, thus the cutter



Left. Travelling control desk with steering control and the two vertical milling head control panels

Panel at the floor mounted master control desk



can be guided round a complicated shape either in the vertical plane or horizontal plane depending upon which milling head is selected for operation.

Feeds for steering are divided into two ranges, i.e., 1 to 10 in. per min and 5 to 50 in. per min, selection of the feed range required being made by means of a rotary switch on the control desks.

The feed control is a ganged arrangement of potentiometers having the characteristics required to provide the correct speed from each motor in order to move the cutter in the direction selected by the steering handwheel. The system is so designed that only one steering handwheel can be in operation at any one time, the desk required for operation being selected from the master control desk.

The control circuits for each of the two drive motors remains essentially the same as for the normal milling operation. However, the two error signals, one to each control system, are derived from a phase sensitive rectifier unit.

The steering wheel moves the motor of a Magslip such that the outputs from its two data windings are proportional to the sine and cosine respectively of the angle of rotation of the wheel. The two signal outputs are applied to the phase sensitive rectifier wherein they are converted to two error signals, one to be applied to the control system governing the table feed motor and the other to the control system for the milling head feed motor.

The Magslip and phase sensitive unit are designed so that the relationship between the steering wheel position (shown by an indicator on the control desks; 0° at North) and the relative speeds of the two motors are as follows:—

Steering wheel	*Speed of table motor*	*Speed of milling head motor*
At 0°	Max. forward	Zero
At 45°	0·707 of max forward	0.707 of max forward
At 90°	Zero	Max forward.
At 135°	0·707 of max reverse	0·707 of max reverse
At 180°	Max. reverse	Zero

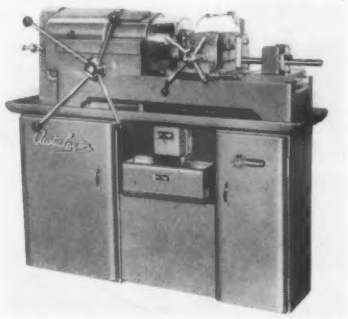
The relative motor speeds for 225°, 270° and 315° are the exact opposites of those for 45°, 90° and 135° respectively.

During the steering control, the vector speed (i.e., the square root of the sum of the squares of the two motor speeds) is maintained constant at the value selected on the steering feed rate control knob. Thus the feed of the cutter is held constant at this value irrespective of the direction of cut. The vector speed is held constant to an accuracy varying from $\pm 1\%$ at maximum speed to $\pm 10\%$ at minimum speed.

Centring and Facing Machine

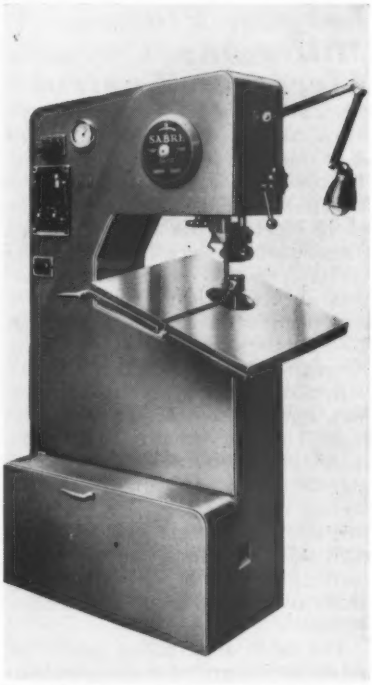
Reducing the centring and facing of bar stock, forgings, etc., to one simple combined operation on one machine, the new "Centamax" made by Austic-Layton Machine Tools, Norwich, offers big time-saving on this and similar work for low capital outlay. In three easy stages stock is loaded into self-centring vice and clamped with star wheel, the sliding headstock is traversed by handwheel less than 1 in. and the work is faced and centred, then the vice is unclamped and stock removed.

The centre drill and facing cutters are combined in one head and it is not necessary to re-chuck the work between the centring and facing operation. The facing is a machined surface so it is not necessary to re-turn the ends when the work is in the copy lathe and as the two operations are combined, the centres must be square with the ends of the shaft. This operation is still further speeded up by the use of the high speed when centring, which is automatically changed over to the slow speed by micro-switch just before the facing cutters contact the workpiece.



The new "Centamax" centring and facing machine. Accuracy of depth of centre is obtained with the setting gauge provided

The machine can be used for many other simple operations—square or radiused recessing, pointing, chamfering, hollow milling, thread rolling, or as special-purpose machine with 6 in. chuck.



The "Sabre" bandsawing. filing and polishing machine is of all-steel welded construction

Fully Equipped Bandsaw

A new bandsawing, filing and polishing machine has been added to the range made by Startrite Machine Tool Company Limited, Darland Hall, Star Mill Lane, Chatham, Kent. The machine, the "Sabre", is of all-steel welded construction and has a large door on one side for access to the band and mechanism. Standard equipment included with the machine are a blade cropper, grinder and gauge, and also a flash butt welder for joining blades. A compression spring saw tensioning device is provided, with a dial indicator showing the correct tension for different widths of blade. The table, which measures 23 in. square, will cant 45° right, 10° left, 5° forward and 5° backward. Among equipment used with the machine are, in addition to the standard saw guides, heavy duty guides, file guides, angled roller guides, screw feed with protractor, circle cutting attachment and irregular shape cutting attachment. The price of the machine is £399.

books

Operational Calculus. By Jan Mikusinski. London, 1959; Pergamon Press Limited. £5 net (by post £5 1s. 9d.) 495 pp. $6\frac{3}{4} \times 9\frac{1}{2}$ in.

Professor Mikusinski uses operators as a kind of fraction in a generalization of the concept of number so that calculation becomes greatly simplified. He presents his subject matter in a way that engineers will find directly useful.

His starting point is the concept of the *convolution* of two functions as a further function defined by a particular integral and the impossibility of performing the inverse operation to convolution leads to an operator in the form of a fraction which can be used arithmetically in all the ways to which fractions are amenable. These are explained in sequence and then the author goes on to show how the use of the operational calculus automatically reduces ordinary differential equations to ordinary algebraic equations; and the theory of the electric circuit provides a wide range of problems illustrating the application of the method.

It is then shown how the operational calculus can be used to advantage in finding general solutions of differential equations, in solving boundary problems; and after introducing discontinuous functions the author goes on to applications to the statics of beams, investigating bending moment, conditions of balance, deflexion, support beams, and statically indeterminate cases.

Thus far we have examined Part I of the book. Part II is concerned with sequences and series of operators, difference equations and power series, and introduces several electrical examples. Part III deals with the operational differential calculus and includes treatment of operational functions and their derivatives, exponential functions; and investigations by operational methods of the vibration of strings, the conduction of heat in bars, the flow of electric current in long telegraphic cables, and an algebraic derivative. An outline of the general theory of linear differential equations with constant coefficients is the subject of Part IV, beginning with homogeneous equations and going on to the non-homogeneous and continuing with applications to partial differential equations. The integral operational calculus naturally follows as the subject of Part V, including the integral as an operational function and integral transformations (the Laplace transform).

The sixth part of the book is an appendix added to this new (English) edition (previous editions have been in Polish, Russian, German, and again in Polish) and it gives proofs of theorems omitted from earlier editions, includes new operational results obtained since the publication of the first edition, a discussion of the relations between operational calculus and other branches of mathematics such as abstract algebra, and the theory of distributions and Banach spaces.

A seventh part lists the special functions referred to in the text, the formulæ of the operational calculus, formulæ of electrotechnical applications, and values of various functions (gamma, error, bessel). There are a good many exercise problems throughout the text, and very usefully, the answers are given at the back of the book. There is an extensive bibliography and an index. The contents pages, rather curiously, are bound in at the back of the book instead of the usual place near the front.

The author is a professor of the University of Warsaw and the book is a methodical presentation of a theory that he published, with applications, at various times between 1950–1957.

The Lead Storage Battery. By H. G. Brown. Altrincham, 1959; John Sherratt & Son. 24/- net (by post 25/-). 166 pp. $5\frac{1}{2} \times 8\frac{1}{2}$ in.

The great advantage of a full and well-informed text, such as the book under notice, on a subject like electric batteries is that it tells so much more than the host of short texts and brief hints with which the battery user is inflicted in manuals prepared primarily for the care of some other machinery to which the battery is regarded as an accessory. Actually it is seldom nowadays any such thing: on the contrary, it is very often a vital part of the plant and as such should receive full care from a well informed owner. Such an owner would have this book at hand.

The author deals with every aspect of the subject, from the chemistry of the lead acid cell to the ionic theory. How batteries are constructed, their arrangement in plant, their application to all purposes, their proper care and maintenance and the diagnosis and treatment of troubles are all clearly and competently dealt with.

Nuclear Technology for Engineers. By R. Hobart Ellis, Jr. New York, 1959; McGraw-Hill Book Company Inc. London; McGraw-Hill Publishing Company Limited, 74/- net (by post 75/4). 284 pp. 6 × 9 in.

Nuclear technology has reached the stage where a lot of either physics or mathematics is not necessary for an intelligent understanding of nuclear processes. It has, in short, become a subject in itself and all sorts of people can approach it with fair success with no more than some other technological or scientific background. This book provides the means of such an approach, the author conducting the reader through the subject by straightforward description for the most part and with but the merest sprinkling of mathematics. He describes the nature of the nucleus, the properties of the different kinds of particles encountered in radioactivity and radiation, how radiation is detected, the use of radionuclides as tracers in biological work and in industry, the sources of high level radiation, the effects and uses of radiation, the radiation dose and its measurement; and then from principles and uses he turns to major sources—fission and the chain reaction, using fission reactors, and finally to fusion, the latest and most promising development for power production.

Economic Control of Interconnected Systems. By Leon K. Kirchmayer. New York, 1960; John Wiley & Sons Inc. London; Chapman & Hall Limited. £5 net (by post £5 1s. 1d.). 207 pp. 6 × 9 in.

The object in power station control is economic operation, often of a power pool formed by several areas and the modern alternative to manual or semi automatic control is com-

puter control which offers opportunities for making savings in operating costs. How this may be done is shown in this book in which the author first analyses the problem of power station control and applies his results to the use of the computer, the economic operation of combined steam and hydro-electric systems, energy accounting in interconnected systems, the analysis of losses and computer control in interconnected areas, and the use of a despatch computer for multi area economic control.

In addition to the use of theoretical and analyser methods of predicting the dynamic performance of interconnected systems and associated controllers, the author deals with the development of mathematical models of processes, the use of advanced circuit methods involving matrix and tensor concepts and Kron's method of diakoptics, the illustration of mathematical methods of determining equations the solutions of which result in optimum performance, and the integration of computer and controller into one system.

The book is a companion volume to the author's *Economic Operation of Power Stations*, and like it is in the series sponsored by the U.S. General Electric Company for the advancement of engineering practice.

The Key to Cost Accounting. By J. A. R. Tainsh. London, 1960; Charles Griffin & Co. Limited. 14/- net (by post 14/8). 119 pp. $4\frac{3}{4} \times 7\frac{1}{4}$ in.

For a business to continue and prosper it is important that those in charge should concern themselves with getting orders and seeing that they are executed promptly, efficiently and profitably. The accountants will keep the books in order and see that money is collected and paid, and will provide accounts and balances as and when required. However happy the position of the company, the executives and scientific or technical directors and managers will at times have to consider the accounts, and it is a fact that not all of them find it easy to get a true picture of the state of affairs from the accountant's figures. The trouble lies in not properly understanding the principles and effects of double entry book keeping. There is no real difficulty: it is mainly a matter of approach. The author of this book, who writes for executives, engineers and scientists from his own knowledge and experience of them, removes the stumbling block by a very simple device which the technical mind can appreciate at a glance. This consists of pairs of scales the balance arms of which are connected by weightless links. The effect is instantly apparent.

By this means he explains all the accounts and the balance sheets. He notes all the items involved and indicates their place in the general scheme and shows how costing is done from the accounts. The book contains a remarkable amount of material in relation to its small bulk. It is certainly just what is needed by large numbers of people.

Russian Journals.—Scientists and students frequently have difficulty in tracing accessible published Russian literature and, with their needs in mind, a list has been compiled of Russian scientific and technical periodicals held by the Manchester Central Library, The Manchester College of Science and Technology Library, Manchester University Library and the Library of the Royal Technical College, Salford. Altogether, 54 titles are recorded, of which 22 are translations. The list has been compiled for the Library Association (Reference, Special and Information Section, North-Western Group) by Mr. George Hill (Manchester College of Science and Technology Library) and is in alphabetical order of the Russian title. There is a full index under transliterated and translated titles. Miss B. M. Walker, M.A., Central Library, Manchester 2, will gladly send copies to readers of MECHANICAL WORLD who wish to have the list.

European transport.—The Annual Bulletin of Transport Statistics for Europe published by United Nations (H.M. Stationery office, price 9/-), observes that the final abandonment of steam traction on all the European railways is to be brought about within a comparatively short time. The increase in the use of oil for all purposes instead of coal has led to a general reduction in tonnage carried, and effect felt particularly in carriage over long distances. The use of pipelines, too, has deprived the railways of some portion of their freight. As usual the bulletin presents a great quantity of statistics set out in tabular and graphical form.

New Standards

Calcium-base greases (B.S. 3223: 1960). Price 7/6.

This new standard rationalizes specifications base by providing a range of calcium greases which satisfy the same general requirements for composition and quality but differ in consistency and in the viscosity of the lubricating-oil component. Twelve categories are included (three consistencies for each of four oil viscosity ranges), and standard designations are given. Requirements are specified for composition, consistency, change in penetration on prolonged working, drop point, free acidity and free alkalinity, water content, oil separation and copper corrosion. Resistance to heat may be specified as an optional requirement for certain categories of grease. Where appropriate, IP methods of test are used. An appendix gives information on the suitability of greases for dispensing by means of lubricating equipment.

Aircraft electrical equipment, Part 3. Characteristics of electrical power systems and equipment (B.S. 2G.100: Part 3: 1960). Price 6/-.

This standard is being revised and Part 3 has been completed and appears in advance of other parts. The complete revised standard will consist of Part 1, Declarations, identification and construction; Part 2, Environmental and operating conditions; Part 3, Characteristics of electrical power systems and equipment; Part 4, Instruments and indicators; and Part 5, Rotating electrical machines. Other parts may be added as required.

British Standards Institution, 2 Park Street, London W1.

ASTM Standards on metallic coated iron and steel products (A-5) Price $3.50.

This 2nd edition is virtually a complete revision of the first edition issued in 1956. Of the 34 standards all but 5 have been newly added, revised, or have had their status changed. Among the materials covered are zinc coated wire, strands, fencing, sheets, pipe and hardware. Also included are aluminium coated wire and aluminium coated iron and steel articles as well as terne-alloy-coated sheets. There are 25 specifications, 6 methods of test, and 3 recommended practices.

(ASTM, 1916 Race Street, Philadelphia 3, Pa.)

BUSINESS & PROFESSIONAL

Personal

AMONGST the recently elected Fellows of the Royal Society are **Mr. Alfred Maurice Binnie,** Reader in Engineering at the University of Cambridge, Department of Engineering—for his contributions to engineering science, particularly in the field of hydraulics; **Dr. Ronald Holroyd,** a deputy chairman of Imperial Chemical Industries Limited, London—for his work on the chemistry and engineering of synthetic fuel production; **Dr. David Keith Chalmers MacDonald,** Principal Research Officer, Division of Pure Physics, National Research Council of Canada, Ottawa—for his investigations on the thermal and electrical properties of metals with particular reference to the study of electron interactions; and **Dr. Albert Alan Townsend,** Assistant Director of Research at the University of Cambridge, Cavendish Laboratory—for his experimental and analytical contributions to the theory of turbulent motion in fluids.

Mr. J. R. Cotterill, J.P., M.I.E.E., M.I.Mech.E., M.I.Mar.E., M.A.I.E.E., has been appointed manager of the outside services department at the Witton Works of The General Electric Company Limited. This is a new department formed to co-ordinate erection, commissioning, and post-commissioning service of electrical plant. **Mr. R. P. Janion** has been appointed sales engineer of the switchgear division at the Witton Works responsible for switchgear for voltages of 3·3 kV and above.

Mr. R. Gore, M.I.Mech.E., A.M.I.P.E., has been appointed to the newly-created post of facilities manager of F. Perkins Limited, Peterborough, responsible for planning, plant, tool room operations, industrial engineering and safety.

Mr. N. E. H. Pearson, A.R.C.T.S., A.M.I.E.E., has been appointed sales manager, cathode ray tubes and receiving valves product departments, A.E.I. Radio and Electronic Components Division. These departments, which supply the entertainment industry, have their sales organizations at 155 Charing Cross Road, London WC2.

Mr. John O. Sewell, has been appointed the new general manager of the British Materials Handling Division and the British Lock & Hardware Division of The Yale & Towne Manufacturing Company, Willenhall, Staffs.

Mr. Frank M. Ryan, director of Norton Grinding Wheel Company Limited, Welwyn Garden City and vice president and general manager of Norton International Inc., has retired after more than 46 years with the company. Earlier in his career he was for a time works manager of the English factory.

BOWMAKER (PLANT) LIMITED dealers for Caterpillar diesel tractors in the Midlands, Wales and south west England announce the appointment of **Mr. Charles Jackson** and **Mr. Ronald Williams** to their board of directors.

S. SMITH & SONS (ENGLAND) LIMITED announce that **Mr. G. B. G. Potter, B.Sc., M.I.Mech.E., F.R.Ae.S.,** whilst retaining the managing directorship, will further concern himself with the direction of the collective research and engineering facilities. **Mr. K. Fearnside, M.A.(Cantab.), A.M.I.E.E., A.F.R.Ae.S.,** is appointed director of research and engineering for Smiths Aircraft Instruments Limited's Research and Engineering; **Mr. G. G. Roberts, M.Sc. (London), F.R.Ae.S.,** remains technical director of Smiths Aircraft Instruments Limited, and as such, he will assist Mr. Fearnside in his new appointment.

Mr. D. R. Mackay has been appointed regional manager of I.C.I. Midland Sales Region in succession to **Mr. T. H. Minton,** who retired on March 31 after 38 years service with I.C.I. and its predecessors. Mr. Mackay is succeeded by **Dr. J. P. Dickson,** who has been assistant I.C.I. sales controller in London since 1958.

Mr. E. F. D. Webb, B.Sc.(Eng), A.C.G.I., has been appointed engineering manager of Hagan Controls Limited.

Mr. E. J. Hudson has been appointed divisional manager of the General Services Division of The Plessey Company Limited, Swindon Region. **Mr. R. E. Leach, M.I.P.M.,** has been appointed regional personnel manager for all the activities of the company in the Swindon area.

Mr. Robert D. Umpleby, who has been director in charge of piston ring production of Hepworth & Grandage Limited, Bradford, and who has played a notable part in the company's development during the past quarter of a century, has retired after 36 years' service.

EDGAR ALLEN & COMPANY LIMITED, Sheffield, announce the appointment of **Mr. W. H. Everard** as deputy general manager of the foundry division, with **Mr. J. M. T. Levesley** as his assistant.

Mr. S. G. Spooner, B.E.M., has been appointed works manager of Marconi Instruments Limited, St. Albans, with responsibility for manufacturing activities, industrial relations, works services and welfare.

Mr. R. Gladwell and **Mr. J. Pollard** have been appointed by Weldcraft Limited, Windsor Works, Slough, Bucks, manufacturers of gas and arc welding equipment and accessories, to represent them in the London N.W. and S.W. areas, respectively, while **Mr. M. Bailey** is appointed for the Midlands. **Mr. J. T. Roberts,** 23 Digby Road, Ipswich, has been appointed agent for East Anglia where he will be responsible for the sale and distribution of all Weldcraft equipment and accessories, including the Gasfluxer process and "Aut-O-Cet" generators.

Mr. A. Nocton, for many years London area sales manager of Hattersley (Ormskirk) Limited, and **Mr. R. Stephen Wild,** of Sheffield, have both been appointed to the board. **Mr. W. Kinsey** is retiring from executive office and from the board after more than 40 years of service with the company and its predecessors in business. **Col. C. A. Hunt** is retiring from the board of Hattersley (Ormskirk) Limited but will continue as a director of Beck & Company (Meters) Limited.

Mr. Michael Wormald has been appointed London area manager of Firth Cleveland Pumps Limited, a member of the Firth Cleveland Group. Other appointments are those of **Mr. R. S. H. Shepard, M.C., T.D., F.C.A.,** and **Mr. L. B. Devins** as joint managing directors of The Sheffield Wire Rope Company Limited, and of **Mr. Gordon Liley** who has been appointed to the board of British Lead Mills Limited.

THE FAIREY COMPANY LIMITED announces the appointment of **Mr. L. R. E. Appleton, O.B.E., M.A.,** as managing director of Fairey Engineering Limited and **Mr. P. J. Duncton, B.Sc.,** (already a director of Fairey Engineering) as general manager, Heston. The Heston, Middlesex, factory is now the new head office of Fairey Engineering Limited. **Mr. H. G. Gregory,** remains director and general manager of Fairey Engineering's Stockport factory.

SOUTHERN AREAS ELECTRIC CORPORATION announces the appointment of **Mr. John Softley** as general manager of their subsidiary, Designs and Installations Limited, manufacturers of packaging and general engineering machinery. The existing board of directors of Designs and Installations Limited comprises **Lord Gridley** and **Mr. J. W. C. Milligan,** following the resignations of **Mr. J. A. Hinds** and **Mr. C. E. Trodd** as joint managing directors.

Mr. W. J. Wyers, F.R.S.A., has been appointed assistant chief designer to the research and development department of Rubery Owen and Company Limited, Darlaston, the parent company of the Owen Organization.

Mr. T. Collier, general manager of The Glacier Metal Company Limited, Kilmarnock, factory has been appointed a director of the company.

Mr. W. G. Friggens, B.Sc.(Hons) A.M.I.E.E., has been appointed director and general manager of Manufacturers Equipment, Company Limited. **Mr. L. D. Dale,** who has been with the company for some time as sales manager, was appointed sales director in January, 1960.

ARUSHA INDUSTRIES LIMITED announce the appointment of three executives to new positions on the Group headquarters staff. **Mr. A. B. Lidderdale, M.I.Mech.E., M.I.Prod.E.,** formerly member of the Cables Group board and deputy to the managing director of Telcon Limited, and director of Toolpro Limited, is appointed personal assistant to the chairman. **Mr. L. Ingham, A.M.I.E.E.,** is appointed group sales manager of Arusha Industries having formerly held the post of assistant general sales manager of Chloride Batteries Limited. **Mr. A. J. Smith, B.Sc., A.M.I.Mech.E.,** was until recently general works manager of the Glacier Metal Company and becomes the Group industrial engineer.

THE NEWAGE GROUP announce the appointment of **Mr. A. D. MacKay** as managing director of Newage Engineers Limited, and to the boards of the subsidiary companies.

SIR W. H. BAILEY & COMPANY LIMITED, (Albion Works, Patricroft, Manchester), has appointed **Mr. B. D. Hayes** to cover the East and West Ridings of Yorkshire. He can be contacted at 1 Ashworth Close, Bakersfields, Nottingham (Telephone: Nottingham 24–8629).

Mr. G. S. G. Blunt has joined the technical sales staff of the process control division of Bailey Meters & Controls Limited, Purley Way, Croydon.

Mr. Gordon Wright, A.M.I.E.E., A.M.I.Mech.E., has joined Electrothermal Engineering Limited, 270 Neville Road, London E7, as chief engineer.

Mr. Thomas P. Everett, B.A., M.I.Mech.E., has joined the board of Hawker Siddeley Brush Turbines Limited as sales director.

ENGLISH STEEL CORPORATION LIMITED announce that **Dr. C. J. Dadswell** has relinquished the office of managing director of Davis & Lloyd (1955) Limited, and is appointed chairman, and **Mr. C. Muirhead, O.B.E.,** takes over the office of managing director of Davis & Lloyd (1955) Limited.

I.T.D. LIMITED, Webb Lane, Hall Green, Birmingham, announce that **Mr. H. C. Hinder,** southern area sales manager, becomes export sales manager, and **Mr. John Lowe,** northern area sales manager, becomes home sales manager.

Mr. Peter M. McKay, previously Holman technical representative for the Essex and E. London area, has been appointed senior technical sales representative for the Holman Group of Companies in all sales and consultancy activities in connexion with the oil industry. He is based at the London office of the Holman Group, 44 Brook Street, W1, but he will spend a considerable time each year visiting overseas oil centres.

Obituary

We regret to record the death of **Alderman J. Louis Brook,** Mayor of Huddersfield. A director for 42 years, and former vice-chairman of Brook Motors Limited, Alderman Brook was the brother of the company's founder, the late Mr. Ernest Brook.

WE regret to record the death of **Mr. Harold Gilbert Ramsell,** general manager of The Yale & Towne Manufacturing Company. A member of the Institution of Mechanical Engineers and the Institution of Production Engineers, Mr. Ramsell had lectured all over the country on the manufacture and design of locks.

WE regret to record the death of **Mr. George Wood, C.B.E.,** vice-president of Thos. W. Ward Limited, Sheffield. Mr. Wood joined the company as a boy in 1897. In 1941 he became joint managing director and deputy chairman and in 1950 was appointed chairman. He relinquished the office of chairman to become vice-president in 1954.

WE regret to record the death of **Mr. Oscar Rendell,** a director of H. W. Kearns & Company Limited since 1927. Mr. Rendell, who had 51 years' service with the company, was a well-known figure in the machine tool world. He was a past president of the Manchester Association of Engineers and a member of the Institution of Mechanical Engineers.

Addresses

THE new Group Engineering Centre of the 25 companies which form the Simms Motor & Electronics Corporation Limited will be located at Western Avenue, Acton, within the premises of Aircraft Steel Structures Limited, a member of the Simms Group, and will undertake design, development and engineering projects for those group companies in which it is considered uneconomic to maintain a separate engineering organization.

VAUXHALL BOILER COMPANY LIMITED is the new name by which Bouëllat Engineering Limited will in future be known. The change is one of convenience and does not involve a change of its structure.

THE telephone number of the Gas Council (Murdoch House, 1 Grosvenor Place, SW1) has been changed to Belgravia 4321.

HAGAN CONTROLS LIMITED, member company of The Plessey Group, is now located at 14 Grosvenor Place, London SW1. Tel. BELgravia 6382.

THE telephone number of the service department of Research and Control Instruments Limited, 49 Temperley Road, Balham, London SW12, has been changed to Battersea 8641 (four lines).

THE Hull branch of British Insulated Callender's Cables Limited now have two new telephone numbers—Hull 24470 and 28367.

THE Glasgow office of Turner Brothers Asbestos Company Limited has been moved to 80 York Street, Glasgow C2. The telephone number and telex address remain unchanged and are Central 2571, Telex 77–113.

FIRTH CLEVELAND PUMPS LIMITED, a member of the Firth Cleveland group, have moved to a 40,000 sq ft factory at Earl Shilton (Telephone Earl Shilton 2071), about two miles from Markfield, Leicester, where the company has been established for many years.

ANDREW FRASER & COMPANY LIMITED, hydraulic pump and valve manufacturers, are now at their new address, 64/65 Vincent Square, London SW1. The telephone number remains VICtoria 6736.

THE telephone number of Anti-Corrosive Finishes Limited of Ashton Road, Bredbury, Nr. Stockport, Cheshire, has been changed to Woodley 2681 & 2682.

THE London sales office of Stockton Chemical Engineers and Riley Boilers Limited has been moved to 232 Bishopsgate, London EC2. (Telephone: Bishopsgate 3575/6).

THE registered office of Chemical Works Projects Limited, the joint company formed by P.G. Engineering Limited (of the Power-Gas Group), Humphreys & Glasgow Limited, and Simon-Carves Limited to supplement their normal activities by undertaking contracts for large fertiliser and chemical projects overseas, is at Simon House, 28/29 Dover Street, London W1.

Dielectric Heating - 2

The ability of dielectric heating to generate heat through the mass of a suitable material provides the following considerable advantages over other heating methods.

1 A body of uniform section and composition is raised in temperature uniformly throughout. Hence there is no waiting for heat to be transferred from an external heat source to the surface of the body and thence to its interior, and this is of particular advantage when the body is thick, and, as is often the case with dielectric materials, has poor heat-conducting properties.

2 The rate of heating of such bodies is, therefore, much faster than by external heating methods.

3 Since there is no external heat source, overheating or burning of the surface of a heat-sensitive material is avoided.

4 High thermal efficiency is achieved.

5 The amount of heat generated in the work is usually predictable and power input and heating time can be under positive control.

6 Production can start immediately after switching on and no current is used, nor heat lost, during periods of shut-down.

7 Vastly increased productivity is obtainable with less labour (usually unskilled), and fewer machines and less floor space are required.

8 Flexibility of layout makes it possible to plan the factory to best advantage, as dielectric heating equipment can usually be inserted directly into the production line.

Dielectric heating: typical application data

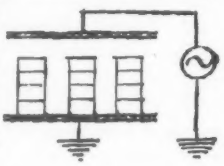
Typical application	Frequency	Radio frequency power
Thermoplastic welding.	20-100 Mc.p.s.	Up to 1 kW
Plastic pre-heating, wood glueing.	10-40 Mc.p.s.	2-30 kW
Plywood manufacture.	2-10 Mc.p.s.	Above 30 kW

Note: 1 Mc.p.s. = 1,000,000 cycles per second.

A few of the industrial applications of dielectric heating are briefly described below.

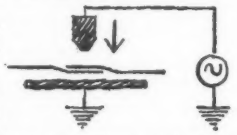
Preheating Thermosetting Plastics

Dielectric heating is the ideal way of preheating moulding powder pellets used in the production of thermosetting plastic mouldings, since these materials are generally poor heat conductors. Properly applied, dielectric preheating promotes faster curing and hence a shorter moulding time, often increasing production ten to fifteen times. There is a marked reduction in tool wear, and thicker sections can be moulded, as the material is plastic when placed in the mould. There is less damage to, and movement of, metal inserts.

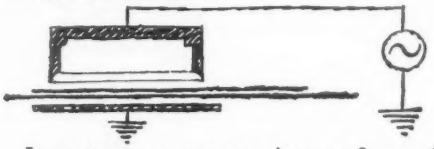


Welding of Thermoplastic Materials

An important and extensive application of dielectric heating in the plastic industry is the welding of thermoplastic sheets in the fabrication of such commonly used articles as raincoats, hoods, handbags, pouches and packaging materials. Dielectric heating is the only method which can usefully be employed since the heating electrodes, and hence the outside sheet surfaces remain cool while the inside surfaces forming the joint are fused, and a perfect weld results.



Two or more thermoplastic sheets are welded under pressure from electrodes suitably shaped to the area of weld required, the current being switched on at the same time as pressure is applied, and off as soon as the weld is completed and the pressure released. Stitching is thus eliminated and a far stronger joint achieved.



In most cases, component pieces are first cut from patterns and preliminary welding carried out to attach any fastening tabs and the like. The pieces are then brought together in a suitable loading frame and the main welding carried out to produce the complete article. In some cases, a suitably profiled electrode can be fitted with a knife edge to cut the sheets immediately outside the weld line, welding and pattern cutting being thereby carried out in the one operation. Dielectric welding can be applied also to very large thermoplastic products such as linings for swimming pools, and cinema screens.

Drying

Drying of materials by dielectric heating has the great advantage that the material tends to dry out from the centre, the reverse of what happens when external heating methods are employed, and the risk of overdrying and overheating of the surface is eliminated. In general ½ to 1 unit of electricity is required to drive off 1 lb. of moisture, depending upon the thermal properties of the material being dried. While the removal of large amounts of water from inexpensive commodities may sometimes be uneconomical, dielectric heating in the production line often leads to a higher overall production efficiency. It is valuable for removing final moisture traces and becomes increasingly economical as the value or heat-sensitivity of the commodity increases.

Rubber

External heating tends to dry and cure the surfaces of a thick latex mass before its centre, but dielectric heating properly applied promotes uniform conditions throughout.

Loaded rubber may not heat uniformly in a dielectric field due to uneven dispersion of its load, but nevertheless rubber preforms loaded up to about 15% are preheated dielectrically to reduce moulding times appreciably, the temperature evening out in the mould to give uniform curing.

Further examples are given in Data Sheet No. 12.

For further information get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2. Telephone: TEMple Bar 9434.

Excellent reference books on electricity and productivity (8/6 each, or 9/- post free) are available — "Induction and Dielectric Heating" is an example.

E.D.A. also have available on free loan in the United Kingdom a series of films on the industrial uses of electricity. Ask for a catalogue.

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Business Developments

Trading agreements

A new company, Hozelock Limited, with offices and factory at Haddenham, Bucks., are now sole manufacturers and distributors of the hose fittings previously manufactured by the engineering division of Airtech Limited.

THE DERI-SINE range of products hitherto sold exclusively in the U.K. by Andrew Fraser & Company Limited, will now also be marketed by Denison-Deri Limited (342 Brighton Road, Shoreham-by-Sea, Sussex), associate company of Deri (Engineers) Limited.

Company acquisitions

G. & J. WEIR LIMITED, have acquired the whole issued share capital of The County Water Softener Company Limited, Purley, Surrey.

A further acquisition is that of a minority interest in the issued share capital of La Societe D'Installations Thermiques et Auxiliaires de Machines (ITAM) of 52 Rue Deguingand, Paris.

THE assets and production capacity of the Steering-Gear Division of George Kent Limited have been acquired by Cam Gears Limited.

THE whole share capital of Fords (Finsbury) Limited of Bedford has been acquired by Tube Investments Limited.

WINSTON ELECTRONICS LIMITED, Shepperton, Middlesex, has become a wholly owned subsidiary of The Dynamics Corporation of America.

Agents and distributors

FOLLOWING the recent appointment of William H. Capper & Co. Limited as U.K. representatives for the compressor division of Demag Aktiengesellschaft, spare parts and service facilities for Demag compressors are now available from Messrs. Capper's Forward Works, Woolston, near Warrington.

THE SELSON MACHINE TOOL COMPANY Limited, a member of the 600 Group of Companies, have recently been appointed sole agents in the U.K. for the range of milling machines manufactured in France by Ateliers Georges Vernier.

THE appointment is announced of Edward G. Herbert Limited, Atlas Works, Levenshulme, Manchester 19, as sole agents in Gt. Britain and Eire for the complete range of Elettrorava balancing machines and equipment made by Ing. A. Rava, Torino, Italy.

WELDCRAFT LIMITED now handle the sales of electrodes manufactured by G. D. Peters & Co. Limited, of Slough.

Contracts and Work in Progress

GENERAL ELECTRIC COMPANY LIMITED.—Further contract from U.K.A.E.A., Risley, for electric furnaces for use in the production of plutonium metal.

Repeat order from Johannesburg Municipality valued at more than £1¼m. for two further 60-MW turbo-generator sets.

E.M.I. ELECTRONICS LIMITED.—T.V. industrial colour installation ordered by Ministry of Aviation.

HEENAN & FROUDE LIMITED.—Order from Bristol Commercial Vehicles Limited for electric dynamometer.

Order from Wartsila Concernen A/B, Tammerfors Linne, Finland, for a Froude FA 10 dynamometer and also from Motor Iberica, Spain.

THOMAS ROBINSON & SON LIMITED.—Order valued at $1m. placed by Liberty Flour Mills Inc. of Manila for the erection and equipping of a complete flour mill.

THE INCANDESCENT HEAT COMPANY LIMITED Smethwick.—Contract value over £1¼m. for steel sheet annealing plant for the new Spencer steelworks of Richard Thomas & Baldwins Limited at Llanwern, near Newport, Mon.

BAKER PERKINS LIMITED, Peterborough.—£¼m. contract for pneumatic handling and mixing equipment to be installed at Shell Chemical Company Limited, Carrington.

LANCASHIRE DYNAMO (M.I. GROUP) through their Central African company.—Order for six 1500 hp water-cooled synchronous motors for the Bancroft mine in Northern Rhodesia.

J. G. STATTER & COMPANY (M.I. GROUP).—Order for metal-clad switchboard for the Durgapur steel works in India.

A.E.C. LIMITED AND SIMMS MOTOR UNITS Limited.—Share of order from Finland for diesel engines and equipment.

P.G. ENGINEERING LIMITED & ASHMORE, Benson, Pease & Company, Africa (Pty.) Limited, Johannesburg (Power-Gas Group).—Order valued at over £1m. for the Rhodesia Broken Hill Development Company Limited.

WILLIAM BAIN & COMPANY LIMITED.—Order for latticed steel towers placed by J. L. Eve Construction Company Limited in connexion with transmission line for the North of Scotland Hydro-Electric Board.

BRITISH INSULATED CALLENDER'S CABLES Limited.—Order from the Lisbon Electric Tramways Limited for the supply and supervision of installation and jointing of 9750 yards of impregnated pressure cable.

A.E.I. (MANCHESTER) LIMITED.—Contract for two 300-MW steam turbine-generator sets for Lakeview power station, Lake Ontario.

GOLDEN JUBILEE

IN March last Acheson Colloids Limited celebrated its Golden Jubilee and also fifty years' association with the City of Plymouth, for it was in 1910 that the founder of the company, Dr. E. G. Acheson, set up a plant in Plymouth. To commemorate its long association with the City, the company at a civic ceremony on March 9, presented through Mr. Howard A. Acheson of New York, president of the international Acheson Organization, a handsome silver "Standing Salt" to the Lord Mayor, representing the City of Plymouth. The Standing Salt is of traditional design and its motifs include many historical symbols associated with the City of Plymouth.

A CAREER IN ELECTRONICS

A liberally illustrated and well set out brochure just issued by E.M.I. Limited of Hayes, Middlesex, explains the various apprenticeship schemes available in the company and details the types of work for which the particular schemes are designed. There are opportunities for apprentices of all educational standards, from secondary modern to university level. Copies of the brochure may be obtained from the Group Personnel Department, Electric and Musical Industries Limited, Hayes, Middlesex.

Trade Literature

Automatic Control of Detergent in Solution

The first of a series of application data sheets comes from Electronic Switchgear Limited, Works Road, Letchworth, Herts. Bearing the number DS160, it deals with the control of detergent strength in wash waters used for bottle and dish washing machines, textiles, electroplating washers etc. Leaflets giving technical details of the company's electrolytic conductivity controller (RC4) and electrolytic conductivity cells (CC), two units used in the system, are also available.

Bitumen Paints

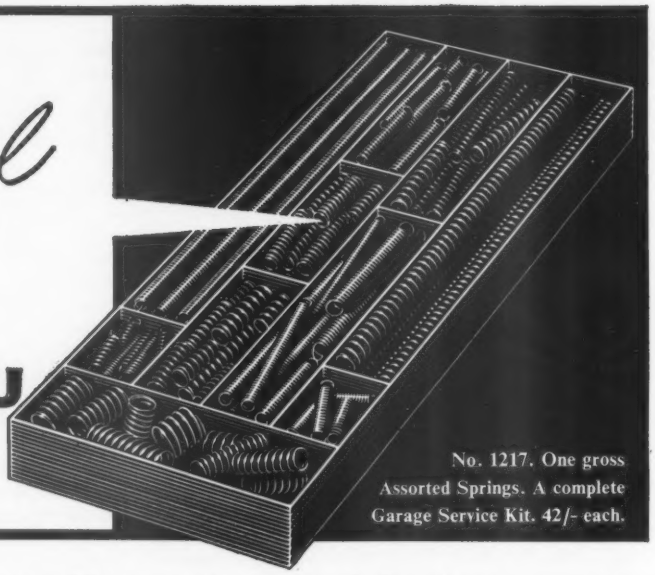
Two new Information Sheets from Premier Bitumen & Asphalte Company (1959) Limited, Western Road, Bracknell, Berks., give particulars of Premier bitumen paints. There is a standard and heavy duty black, a bitumen based on aluminium which has a pleasing appearance, and coloured paints in green, grey and red. Particulars are given of application and coverage.

Mr. Therm at Work

An eight-page, two-colour booklet produced by The Gas Council, 1 Grosvenor Place, London SW1, gives factual information about the industrial therm in a popular, non-technical way. The examples given of the use of an industrial therm vary from drying the backing of wax duplicating stencils to frying fish and chips; from metal melting to producing the glassware for 70 electric lamps.

(*Continued over*)

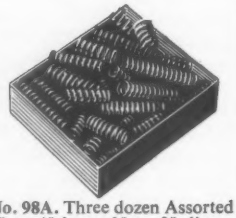
THAT *Experimental Spring* YOU WANT IS WAITING FOR YOU IN THIS BOX...



No. 1217. One gross Assorted Springs. A complete Garage Service Kit. 42/- each.

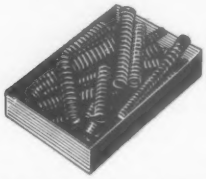
If not, try another box in the Terry Assorted Springs range

No. 1200. Three dozen Assorted Light Expansion Springs, suitable for carburettor control, etc. **13/6.**

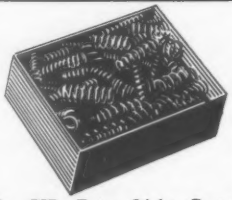


No. 98A. Three dozen Assorted 1" to 4" long, $\frac{1}{2}$" to $\frac{3}{4}$" diam., 19G to 15G. **5/6.**

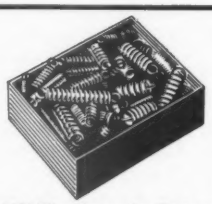
No. 753. Three dozen Assorted Light Expansion $\frac{1}{4}$" to $\frac{1}{2}$" diam., 2" to 6" long, 22 to 18 S.W.G. **10/6.**



No. 760. Three dozen Assorted Light Compression Springs. 1" to 4" long, 22 to 18 S.W.G., $\frac{1}{4}$" to $\frac{1}{2}$" diam. **6/6.**



No. 757. Extra Light Compression, 1 gross Assorted, $\frac{1}{4}$" to $\frac{7}{16}$" diam., $\frac{1}{2}$" to 2$\frac{1}{2}$" long, 27 to 19 S.W.G. **15/-.**



No. 758. Fine Expansion Springs. 1 gross Assorted $\frac{1}{4}$" to $\frac{3}{4}$" diam., $\frac{1}{2}$" to 2" long, 27 to 20 S.W.G. **15/-.**

We know *exactly* how difficult it is to find springs for experimental work . . . we've been making quality springs for over 100 years. So, we confidently offer you our excellent range of small boxed assortments which covers a very wide range.
We can only show a *few* boxes. Send us a p.c. for our full list.
If ever you are stuck with a spring problem let our Research Department put their long experience at your disposal.

Have you a Presswork problem?

If so, the help of our Design Staff is yours for the asking.

TERRY'S *for SPRINGS*

Really interested in Springs? "Spring Design and Calculations" 9th Edition tells all—post free 12/6.

Cut Production Costs with Terry's Wire CIRCLIPS. We can supply immediately from stock—from $\frac{1}{8}$" to $\frac{5}{8}$".

Looking for good Hose Clips? Send for a sample of Terry's Security Worm Drive Hose Clip and price list.

HERBERT TERRY & SONS LTD

Redditch, Worcs.

(Makers of Quality Springs, Wireforms and Presswork for over 100 years)

HT30

Morganite Carbon Bearings

Morganite carbon bearings are for special purposes where ordinary bearings are unable to cope with the work demanded of them. Carbon can be run dry or in fluids which are corrosive or unsuitable as lubricants with other bearing materials, thus it is invaluable in textile and food machinery, in furnace and boiler equipment, and where bearings are immersed in liquids. Designers and users of machinery involving such problems will find ample technical data with useful charts and an example calculation in a new publication, No. SD63/59, which is now available from The Morgan Crucible Company Limited, Battersea Church Road, London, SW11.

Comet Welding Process

Rockweld Limited, Commerce Way, Croydon, Surrey, have produced a new brochure which describes their recently-introduced Comet process of semi-automatic welding with CO_2 shielding in which the arc is struck between a special composite continuous wire and the workpiece in an atmosphere of carbon dioxide gas. The wire contains the deoxidizing agents and the slag forming materials, whilst the carbon dioxide protects the metal from atmospheric contamination during transfer and in the weld pool. It is thus a visible arc process and is readily adaptable for both automatic and semi-automatic operation.

Rare Earth Metals

For some years Johnson Matthey & Co. Limited have produced the rare earths and recent research into the application of ion-exchange techniques to the separation of these materials has made them available in large quantities, in various grades of purity, and at much lower cost than hitherto. New techniques have also been applied to the production of the rare earth metals and all the fourteen "lanthanons" that occur naturally and the related elements scandium and yttrium are now available in a state of high purity. All of the sixteen metals have been remelted into ingots or rods. Lanthanum, cerium, neodymium, praseodymium, yttrium and gadolinium have been successfully extruded, and subsequently drawn to fine wire. A publication, "Products of the Rare Earth Group", just issued by the company, describes the properties, characteristics and availability of this potentially valuable and very topical range of materials. This is available free on request to the company's head office at 73-83 Hatton Garden, London EC1.

Pressure Vessels

The Hadfields group of companies have accumulated a great fund of experience in the manufacture of pressure vessels of all types, and all sizes up to the largest. They make them as forgings, steel or iron castings, weldments, and as centrifugal castings in cast steel, iron or non-ferrous metals or as combinations of these methods. The range of work of this kind which they are accustomed to carry out is explained in a new illustrated brochure (No. 544) now available from Hadfields Limited, East Hecla Works, Sheffield 9.

Ribble Clutches and Variable Speed Units

Two new leaflets from B. & F. Carter & Co. Limited, Albion Works, Bolton, give details of the Ribble centrifugal clutches and the Ribble infinitely variable speed unit. The former caters for horse powers from ½ to 9, and the latter from 0·76 to 2·0.

Trade Literature

Readers interested in any of the catalogues reviewed here can obtain copies by mentioning MECHANICAL WORLD ***when writing to the firms concerned.***

Precision Grinder

The latest addition to the range of grinding machines made by Rudkin & Riley Limited, Cyprus Road, Aylestone, Leicester, is a precision internal and external grinder with automatic grinding traverse, micro-feed for headstock cross traverse, and a headstock which swivels through 120°. Full particulars of the machine and its accessories are set out in illustrated leaflet no. 2018/4 available on request from the company.

Voltage Regulators and Adjustable Auto-transformers

Two new catalogues from Claude Lyons Limited, Valley Works, Ware Road, Hoddeston, Herts., are S-592 which describes their automatic voltage regulators and stabilizers, and V-599 on "Variac" adjustable auto transformers. The regulators are made in great variety to cover the many applications in which improved performance can be obtained from equipment powered from a.c. mains if the voltage is stabilized. The Variac autotransformers are made in units and gauged assemblies and for manual or motor drive.

Nycor Belting

A new leaflet from Graton & Knight Limited, Warwick Road, Boreham Wood, Herts, lists a dozen claims for a new belting called Nycor, developed last year by their American associates and which is now being manufactured in the Hertfordshire works. The belt is basically an orientated plastic of the nylon type with a built-in woven nylon fabric which prevents splitting, and top quality chrome leather covers. Eight times the strength of conventional leather belting, absence of permanent stretch, the grip of chrome leather and an 'endless' joint all combine to give a belt which is very suitable for the high-speed, short centre, individual drive. Four types are being manufactured, ranging from a very thin plastic core with a single leather cover (for light high-speed drives) to a double ply of heavy plastic with heavy leather covers (for main drives).

Standard High Temperature Furnaces

A new folder from Metalectric Furnaces Limited, Cornwall Road, Smethwick 40, Staffordshire, lists four standard sizes of high temperature electric furnaces suitable for both laboratory and workshop use. They range in rating from 15 to 60 kW and in usable dimensions from 12 in. × 6 in. × 4 in. to 36 in. × 18 in. × 12 in. The door is balanced and may be arranged for hand. foot or pneumatic operation.

Hydraulic Machinery

John Shaw & Sons (Salford) Limited, Wellington Works, St. Stephen Street, Salford 3, Lancashire, who have been making hydraulic presses since about 1850, show the great range and variety of the work they do at the present day in their new catalogue, No. 59. Illustrated are presses of all sizes for many industries, and also hydraulic pumps, accumulators and control valves.

Vacuum Coating Units

The wide variety of applications for vacuum coating is shown in a new catalogue from Edwards High Vacuum Limited, Manor Royal, Crawley, Sussex. It describes plant suitable for lens blooming, front surface mirrors, interference filters, cathode ray tubes, quartz crystals, selenium rectifiers and the roll coating of tissue for paper capacitors. There are ten standard models of "Speedivac" plant for these various purposes, and in general applications can be satisfied from plant within this range. For unusual requirements the company build special plant and some examples of the kind are illustrated.

Electrode Salt Baths

Metalectric M.T.S. medium temperature electrode salt baths are used for case hardening, pre-heating high speed steels, hardening alloy steels, and heat treatment processes generally in the 700°–1000° C range. Automatic control is provided and different bath constructions are available for different salts. Full technical details are set out in a new folder No. M18A issued by Metalectric Furnaces Limited, Cornwall Road, Smethwick, Staffordshire.

(*Continued over*)

TRADE LITERATURE

Rocol Molybdenized Lubricants in Coal Mining and Heavy Duty Machinery

A new technical publication of Rocol Limited, Swillington, near Leeds, entitled "Applications of Rocol Molybdenized Lubricants to Coal Mining and Associated Equipment", lists the typical uses of Rocol molybdenized lubricants under the arduous conditions of mining. Naturally, the recommendations also stand for the use of the lubricants in similar types of mechanisms in other industries. The publication gives the recommended detailed part applications to all makes of colliery machines and equipment: coal cutters, coal loaders, coal drills, air breakers and hydraulic pit props, underground. On the underground and surface recommendations are made for radial air engines, pneumatic equipment, conveyors, crushers, vibrating screens, blast stowing machines, winding gear, cage guide ropes, and electrical applications including motor seals, fan bearings, winding gear motor bearings, electric motor bearings, motor gear boxes and switchgear.

Morris Cranes

Morris standard electric cranes are deservedly popular with all manner of industries by reason of their many advantages, not least their economy and outstanding efficiency. A new edition of Section 10 of the Morris catalogue shows clearly that the company is not by any means concerned solely with the building of standard cranes, in fact it would be more correct to say that it has standardized on a wide range of crane components from which it is able to build almost any class of crane to meet specific needs. Along with standard cranes up to 100 tons capacity for general duties, the company is equally noted for its cranes for special, heavy and continuous duties up to 200 tons capacity. The illustrations in the new brochure give some idea of the excellent facilities with which the company is equipped, and gives also tabular details of the standard range of from 1 to 100 tons capacity. The new publication is available from Herbert Morris Limited, P.O. Box No. 7, Loughborough, Leicestershire.

Pipe Thermocouples

A leaflet from the Cambridge Instrument Company Limited, 13 Grosvenor Place, London SW1, describes thermocouples for checking the temperatures of piping up to 300° C. A piece of stainless steel ribbon is used to attach the thermocouple to the pipe, whether temporarily for making a check or permanently for an indicating installation, and is fastened by thumbscrews. The one size of head can be attached to any size of pipe.

Precision Cut Gears

A leaflet from H. Woollacott & Co. (Gear Cutters) Limited, Worsley Gear Works, Mosley Road, Trafford Park, Manchester 17, illustrates some examples of precision gear cutting done by the company to customers' requirements. The company have facilities for making spur gears up to 40 in. dia, bevels up to 20 in., helicals up to 24 in., racks up to 6 ft long, and internal gears up to 30 in. dia. Chain and sprocket wheels are made and rotary shaping cam cutting undertaken. Any quantity from single gears to production lots are customarily undertaken. The company also manufacture "windmill" fractional horsepower geared motor units.

Desalting Brackish Water

The exploitation of agricultural and mineral wealth has often to be carried on in places where the natural water supplies are brackish. The electrodialysis plants developed by William Boby & Co. Limited, Rickmansworth, Hertfordshire, make use of the fact that saline water is an electrolyte. In the plant the sodium and chlorine ions are separated when an electric current is passed through the solution, and are "trapped" in alternate compartments in a stack of plastic membranes. Desalting takes place in every second compartment and it is from these that the potable supply is drawn. The plant is fully described in a folder available from the company at the address given above.

Sifbronze Price List

The new and revised edition of their price list issued by The Suffolk Iron Foundry (1920) Limited, Stowmarket, shows how the company's range of products has steadily widened during the past twelve months. For the first time the list includes the clockwork Colibri and the all-electric Combi cutting machines. The new rods featured are Sifbronze Process 101 and Sifbronze Process 104 Flux-coated rod, together with the new Sifcupron No. 17 drawn rod which until recently the company had only been able to supply as a cast rod. This new rod is available down to $\frac{3}{32}$ in. dia.

Larcher Cutters

The new factory of Larcher Cutters Limited, Moor Lane, Witton, Birmingham 6, and the history of the firm in its first decade form the subject matter of a new booklet. The firm uses its own cobalt alloy treated by a specially evolved process to make cutters of exceptional properties which are able to cut hardened die steel.

Fire Fighting Equipment

A new catalogue from Nu-Swift Limited, Elland, Yorkshire, greatly simplifies the task of making provision for dealing with the different kinds of fire hazard. With the information there clearly set out it is easy to select the right type and size of appliance and to put it in the right place.

Chatwin Small Tools

A range of small tools manufactured by a new process, which gives them a life increase of up to 400%, is described in a new 10 page illustrated catalogue available from Thomas Chatwin & Co. Great Tindal Street, Birmingham, a member of the Brockhouse Organization. Manufactured under the Diamond Brand Trademark, these special tools include drill points for cast iron, concrete-lined or asbestos water mains, circular form tools, swage punches and dies and thread rolls. The catalogue also contains details of the company's standard range of precision thread milling cutters, hobs and chasers, flat and circular form tools, thread rolls and thread crushing rolls.

Rocol Lubricants for Iron and Steel Plant

Comprehensive details of the application of Rocol molybdenized lubricants to the heavy industrial processes of the iron and steel industry are given in a new information publication which is available from Rocol Limited, Rocol House, Swillington, near Leeds. A great variety of machinery is listed and against each item the appropriate Rocol lubricant is specified and notes given as to the method of using it. Rocol specialized industrial molybdenized lubricants are used by many of the iron and steel producers and fabricators in Britain and some overseas.

Safety Ladder Feet

A useful safety device for factory ladders is described in a new leaflet issued by Vulcascot (Great Britain) Limited, 87/89 Abbey Road, London NW8. It consists of a pair of feet which are bolted to the ladder legs (the one assembly caters for legs of 1 in., $1\frac{1}{4}$ in. and $1\frac{1}{2}$ in. thickness) and which have universal connexions to rectangular bases fitted with oil resistant ribbed rubber designed not to slip on the floor but not to stick to it. Adaptors are available for fitting the feet to metal ladders.

Expandite Products

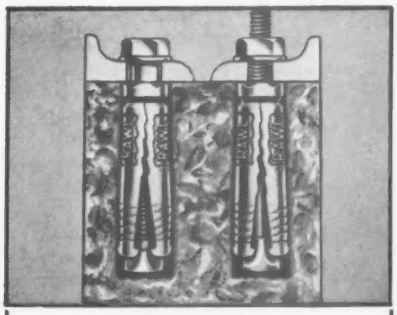
The general catalogue of Expandite Limited, Chase Road, London NW10, shows a wide range of joint fillers, sealing, glazing, caulking compounds etc. as well as a number of anti-corrosion products, fixing devices, pressure guns and the like.

Disposal of Used Soluble-oil Emulsions

The latest Industrial Technical Bulletin from the Mobil Oil Company Limited, Caxton House, Westminster, London SW1, deals with the problem of disposing

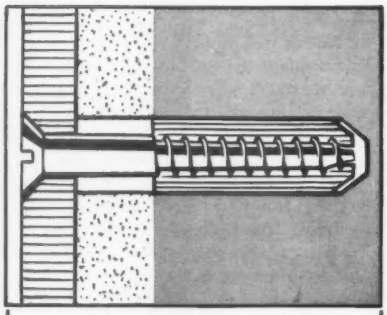
SOLVE YOUR FIXING PROBLEM WITH ONE OF THE 21

However tough or awkward the material into which you want to fix, or difficult the problem, there will be among the 21 TYPES OF RAWLPLUG FIXING DEVICES, the right answer. Speed and simplicity of application, reliability and complete security, coupled with the RIGHT solution to a problem, are the foundations of the RAWLPLUG FIXING TECHNIQUES.
A comprehensive catalogue showing these fixings in detail, together with their application, will gladly be forwarded to you on request.



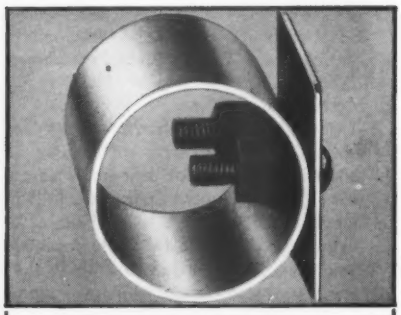
BOLT FIXINGS

With **RAWLBOLTS** a bolt fixing job is done in minutes, as against days by earlier methods. Simply drill the hole, drop in the **RAWLBOLT**, put into place the unit to be held, tighten up and the **RAWLBOLT** is ready to take the maximum load that the bolt, or the material into which it is fixed, will stand.
For extremely wet or corrosive locations, use Rawlplug Caulking **BOLT ANCHORS**; for securing metal threads in masonry—**RAWLTAMPS**. Where fixing points can be predetermined before pouring concrete, use **CEMENT-IN SOCKETS**, thus obviating the need for hole-boring.



SCREW FIXINGS

For making neat, absolutely firm screw fixings in masonry, indoors or out, the famous **RAWLPLUG** is still vastly quicker and more efficient than any alternative method. Rawlplugs are waterproof and quite unaffected by climatic conditions. They are available for all screw sizes up to ⅜" diameter Coach Screws.
For fixings that are to be subjected to high temperatures, or in under-water conditions, use **WHITE BRONZE PLUGS** with stainless steel or cadmium plated steel screws. For fixings subject to corrosive fumes or liquids, use Rawlplug **LEAD SCREW ANCHORS** with stainless steel screws.



CAVITY FIXINGS

The **RAWLNUT**—an ingenious device for fixing into any hollow materials. Inserted and fixed from the outside, it forms its own anchorage within the cavity; and provides a vibration-proof, watertight and **AIRTIGHT** fixing. In addition a type can be supplied to give adequate protection to the screw **IN THE CAVITY**.
SPRING TOGGLES make firm fixings in thin and structurally weak materials such as plasterboard, ceilings, etc. The wings of the device spring apart behind the material and spread the load. **GRAVITY TOGGLES**, for use in hollow wall materials, position their toggles by the action of gravity.

THERE ARE 21 DIFFERENT TYPES OF

RAWLPLUG WALL PLUGS

FIXING DEVICES

and an all-inclusive range of high performance hole-boring tools, hand or power.

B447

THE RAWLPLUG COMPANY LIMITED • CROMWELL ROAD • LONDON, S.W.7

of waste petroleums—base soluble-oil emulsions used in metal-working processes. Methods are described for reducing oil content so that the water part can be put into sewers, streams or lakes without contravening pollution laws and regulations.

Safety Gin Wheel

A new gin wheel designed to provide maximum safety and easier and faster fixing is described in a leaflet from the Building Equipment Division of Scaffolding (Great Britain) Limited, Mitcham, Surrey. A drop forged swivel ring replaces the usual hook. The 10 in. dia pressed steel wheel has a self lubricating Oilite bearing and is mounted in a welded steel frame.

N. Ireland Freight Services

The second edition of the guide to freight services to and from Northern Ireland is now available, free of charge, from the Northern Ireland Development Council, 13 Lower Regent Street, London SW1. Details are given of all the sea and air services available and of the facilities at each port.

Fork Trucks and Mobile Cranes

Two new catalogues can now be had from Ransomes & Rapier Limited, Waterside Works, Ipswich, describing the Rapier fork trucks and fork truck cranes, and the rapier range of mobile cranes and fork trucks. There is a wide range of sizes and types to suit every purpose.

New Factories

Carlisle. Cowans, Sheldon and Company Limited, cranemakers and engineers, are to extend their works at Harraby Green. The architects are Johnston and Wright, Castle Street.

Northmix Ready Concrete Limited, Blackburn, are to erect a concrete making plant on the Willow Holme industrial estate.

Easington. The Durham Coal Board (No. 3 Area), Castle Eden, are to erect a dry cleaner building at Horden Colliery.

Gateshead. Grieves and Elliott, Limited, upholsterers, Stoddart Street, Newcastle upon Tyne, propose furniture factory at East Gateshead.

Hebburn. George Angus and Company Limited. The contract for the works extensions has been let to R. Bowey and Sons, William Street South, Gosforth.

Jarrow-on-Tyne. Northern General Transport Company Limited. The contract for the erection of a garage to accommodate 30 buses has been let to Bewley and Scott Limited, Dunston-on-Tyne.

Jarrow. Pyman Bell and Company Limited, 65 Quayside, Newcastle. The architects for the proposed erection of sawmill, offices, stores, and canteen in Straker Street are Matkin and Hawkins, Barclays Bank Chambers, Fawcett Street, Sunderland.

Newburn-on-Tyne. The Metal Box Company Limited are to construct a factory for the making of plastic containers at Newburn trading estate.

Newcastle upon Tyne. British Engines Limited. Plans approved for extending machine shop at Glasshouse Street.

The C.W.S. Manchester, are seeking a site of about three acres at Newcastle for the erection of a large traffic department. The society's architects' department is at 90 Westmorland Road, Newcastle upon Tyne.

North Shields. G. Davidson and Sons Limited, Whitley Bay. The architects for a proposed automobile factory at Walker Place, North Shields, are Wood and Pigg, 17a Northumberland Square.

South Shields. Harton Dyeworks. Extensions costing about £120,000 to start soon. The architects are Page, Son and Hill, 75 King Street, South Shields.

Stockton-on-Tees. John Graham (Quarries) Limited, Piercebridge, Yorkshire, are to erect a ready-mixed concrete plant on Fewsters nursery site.

Sunderland. George Clark (Sunderland) Limited, are acquiring land for further extensions to their works at Southwick.

Annan. Airscrew Company and Jicwood Limited, Carlisle Road, have received permission to build a second chipboard factory.

Basildon. Thompson & Foster (Containers) Limited, Paycoske Road. The contract for extensions has been let to Hoskins & Son Limited, Rayleigh. The architect is K. F. Wray, 43 Wellington Square, Hastings.

Berwick. Pringle of Scotland Limited, are to make extensions to their factory on the Tweedmouth trading estate.

Birmingham. R. Harris (Brassfounders) Limited, 55 Newhall Hill, are to build new premises.

Bolton. The Walmsleys (Bury) Limited group of companies, Atlas Mills, propose to erect a new factory.

Farnworth Engine Waste Company Limited, Oakbottom Mill, Oakbottom Road. Extensions to works.

Bootle. R. Greaves & Son Limited, 104–118 Derby Road, are to make extensions to their factory.

Bourne. W. Pinder & Son, Spalding Road. Plans have been approved for extensions.

Bournemouth. Cummings & Morrish Limited, 102 Evering Avenue, Parkstone. Factory extensions.

Coventry. Salt Engineering Company (Coventry) Limited, St. John Street, are to build a new factory at Bishop Street.

Dover. E. M. Gheysens Limited, Engineering Works, Buckland Bridge. A new factory is to be built at Lorne Road.

Enfield. The Enfield Tool Manufacturing Company Limited, Alma Road, are to make extensions to their factory.

Falkirk. British Aluminium Company Limited, Norfolk House, St. James's Square, London SW1, are considering extending their factory.

Goole. Crendon Concrete Company Limited, Long Crendon, Aylesbury, are to erect a new factory at Rawcliffe Road industrial estate.

Guildford. Durable Plastics have submitted plans for the second stage of extensions to their factory at Woodbridge Meadows.

Harrogate. Richard Craven & Company, 17 Princess Street, are to erect a new factory at Camwall Road.

Hemel Hempstead. Addressograph-Multigraph Limited. Works to be extended.

Maidstone. Drake & Fletcher, Broadway, are to erect a new factory on the Park Wood Trading Estate.

Mansfield. Hermitage Engineering (Mansfield) Limited. Extensions are to be made to the factory at Hermitage Avenue

Paisley. R. F. Morrison & Company, 106 Crow Road, Glasgow. Plans have been approved for the erection of a new factory at Hawkhead.

Portsmouth. Dellagana & Denby Limited. Extensions are to be made to the factory in Dundas Lane.

Dragonair Limited, Fitzherbert Road. Factory extensions.

Reading. Star Upholstery Company Limited, 5 Station Road and Greenslade & Company, King's Bridge. Factory sites to be offered.

Redditch. Plant Engineering Limited. Extensions are to be made to the factory at Arthur Street.

Romford. Hollingsworth Marshall & Company Limited, Faringdon Avenue. The architect for extensions is M. Brashier, 11 Gayfere Street, London W1.

Rotherham. North Central Wagon & Finance Company Limited, Moorgate. The architects for extensions to works are J. Mansell, Jenkinson & Sons, 53 Wilkinson Street, Sheffield.

Rutherglen. British Chrome & Chemicals Limited, are to extend their factory in Glasgow Road.

Southampton. Renault Limited, Western Avenue, London W3, are to build a new factory.

Surbiton. Ideal Hardening Company Limited, Davis Road. Extensions to factory.

Crystal Products Limited, Park Rise. Factory is to be re-built and extended.

Teddington. Technical Platings Limited, 10 Luther Road. Extensions are to be made to the factory.

Walsall. Birks & Co. Limited, Bentley, are to erect a new factory at Fryers Road, Bloxwich.

Wembley. Velvet Crepe Paper Company Limited, Woodside End, Alperton. Extensions are to be made to the factory.

West Bromwich. The Sandwell Engineering Company Limited, Whitehall Road, are to make extensions to their press shop.

West Thurrock. Thomas Hedley & Co. Limited, are to make extensions to their factory.

Wolverhampton. Lang Pneumatic Limited, 78a Birmingham Road. Extensions are to be made to the factory at Owen Road.

Goodyear Tyre & Rubber Company Limited, Bushbury. The factory is to be extended.

Worthing. C. L. Bencard, 24 Minerva Road, London NW10, are to make extensions to their works.

Glasgow. F. Miller (Textiles) Limited, have received permission for the erection of a factory at Raithburn Avenue, Glasgow S4, in the Castlemilk Industrial Estate area.

Regent Oil Company Limited, have received approval for a heavy oil installation unit at Govan Goods Station, Broomloan Road.

Remington-Rand Limited, are to extend their Hillington plant by 130,000 sq ft.

Mersey Insulation Company Limited, have received approval for the erection of a single storey factory at Mavis Bank Quay.

Newarthill, Lanarkshire. Costain Concrete Limited, are to locate a new unit here for the production of Siporex, the Swedish building board material, for which Costain have been appointed sole manufacturers in Great Britain and Ireland.

CLASSIFIED ADVERTISEMENTS

Machinery, Plant and Accessories For Sale

ROBERTSON 7-STAGE SECTION FORMING MACHINE with additional curving unit. Specially suitable for profiling and bending stainless steel sections. Drive is by 20 hp motor through 3-speed gearbox. Diameter of roller shafts, 2 in. Length of shafts available for forming rollers $8\frac{7}{8}$ in. Rolling speeds with 6 in. diameter rollers, 40, 80 and 120 feet per minute. Weight about $11\frac{1}{2}$ tons. Full details and illustrations from F. J. Edwards Limited, 359-361, Euston Road, London NW1 or 41, Water Street, Birmingham 3.

"FRIGIDAIRE" Low Temperature Refrigerators. 49 in.w × 28 in.d × 34 in.h ext. Ex Large National User, suitable A.C. or D.C. Deep Freezing, Storage of Ice Cream, Frozen Foods, etc. Price £40.0.0 each. Domestic Refrigerators, Service Cabinets and Cold Rooms also available. A.R.C., 134 Great Portland Street, London W1. MUSeum 4480.

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PUMPS for all purposes. R. L. Christiansen Limited, Wordesley, Stourbridge. Brierley Hill 78184/5.

Patents For Sale or License

THE proprietors of Patent No. 722778 for "Small Portable Typewriter" desire to secure commercial exploitation by License or otherwise in the United Kingdom. Replies to Haseltine Lake & Company, 28 Southampton Buildings, Chancery Lane, London WC2.

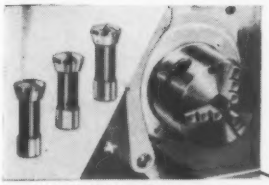
Classified advertisements are inserted at the rate of 3/- per line.

THE proprietor of British Patent No. 718976, entitled "IMPROVEMENTS IN OR RELATING TO COUPLINGS FOR RODS, TUBES AND THE LIKE", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 760973, entitled "MACHINE FOR APPLYING MATERIAL TO WALLS AND OTHER OB'ECTS" offers same for license or otherwise to ensure practical working in Great Britain. Enquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

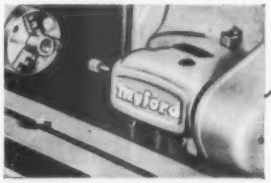
MYFORD

MG·12 Grinder



Extra Work Holding Collets up to ¼ in. diameter capacity for direct fitting into the bore of the spindle. 3½ in. dia. 3-Jaw Precision Self Centring and 4-Jaw Independent Chucks supplied extra.

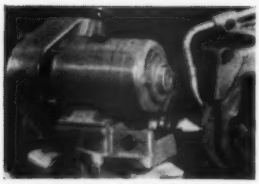
Work speeds for the 'Dead or Live' Workspindle are electrically regulated in two ranges of six speeds, the appropriate range being set by vee belt transfer, and the individual speed by selector switch.



Removable type Internal Attachment available (as extra equipment) for mounting on the front of the wheelhead.
Grinding diameter: 0·25 in. to 3 in. (6·5 mm. to 75 mm.).
Grinding depths to 3 in. (75 mm.).

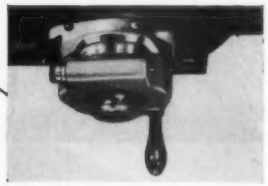
Send for full details to:—

MYFORD ENGINEERING CO. LTD.
BEESTON · NOTTINGHAM · ENGLAND



The extra equipment 'live' spindle Swivelling Workhead features: Plug-in facility, Rapid changeover from standard, Large spindle flange, Reversing switch for face grinding, 12 spindle speeds 65 to 670 r.p.m., etc.

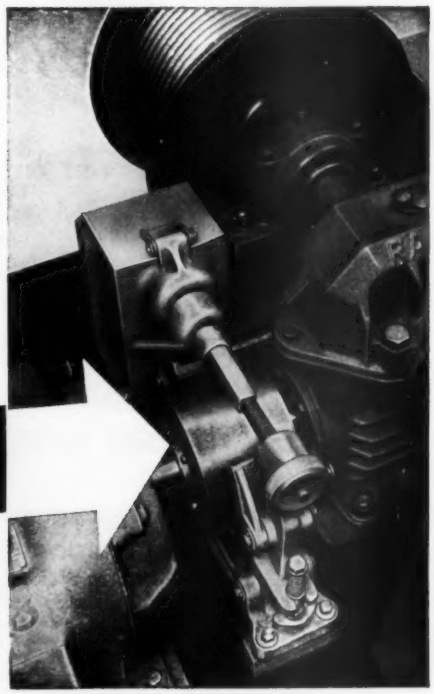
'Myford' Cartridge type wheel spindle unit with spindle of nitralloy steel. Single, graduated, collar adjustment. Easily replaceable. Ample capacity oil reservoir and circulating pump ensure constant lubrication.



Wheelfeed index dial engraved with 0·0001 in. divisions of infeed. Graduated thimble gives micrometer control of index representing 0·000025 in. infeed per division; dead stop for repetition work; hardened feed screw with ground thread.

CONTROLLED TRANSMISSION

with
BROADBENT AUTOMATIC CENTRIFUGAL CLUTCH COUPLINGS is reliable shock-proof transmission—eliminating starting and overload troubles and increasing the effective life of motor and machine. The new bonded linings give smoother engagement, quieter running and longer service without replacement.



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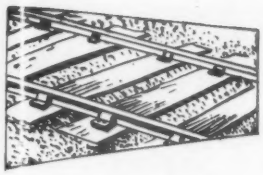

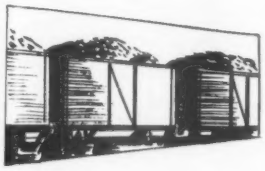

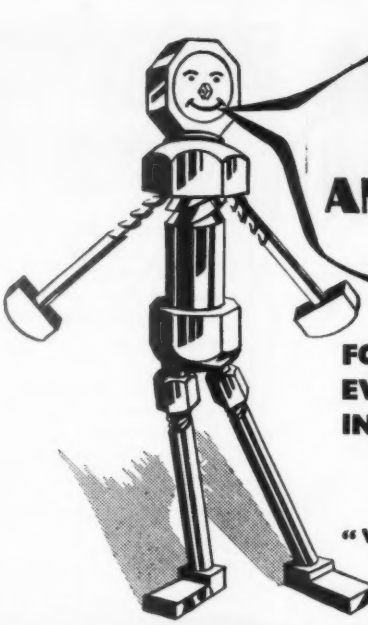

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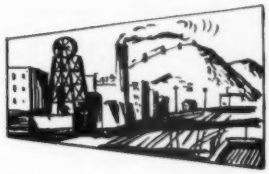

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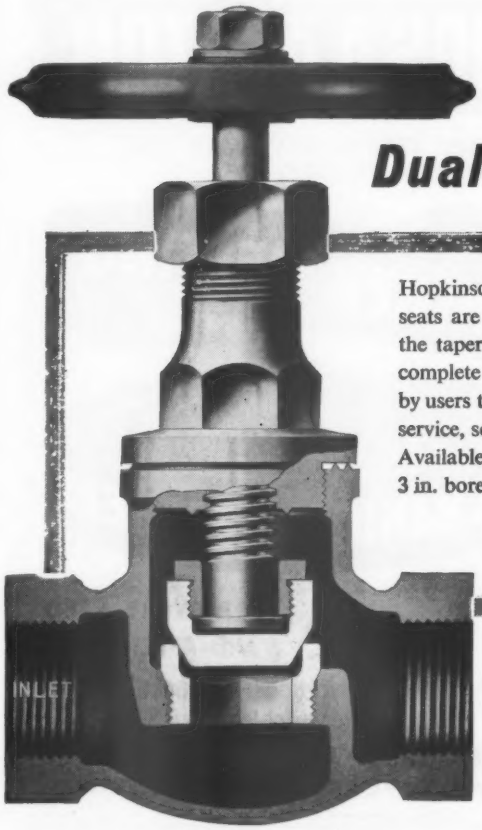

Dependable Dual-Purpose Bronze Valves

Hopkinsons' "S.T.S." bronze valves, with their mitre-faced valve heads and seats are suitable for use as either isolating or regulating valves. Note how the tapering metal-to-metal joint between body and seat helps to ensure complete fluid-tightness. This range of small valves, in fact, is acknowledged by users to be exceptional for maintaining tightness over very long periods of service, so simply are they designed and so sturdily made.

Available in sizes ¼ in. to 3 in. bore with screwed connections, and ½ in. to 3 in. bore with flanged connections.

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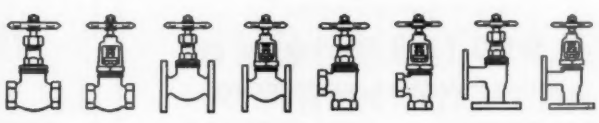

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. . . not more than a shilling, maybe, but a single damaged bolt or other screw threaded part can cost pounds if a replacement is not readily available and essential machinery is standing idle. Why take chances when the certain safeguard costs only 27/6d? Put a Bolt Saver in your tool kit NOW before the next breakdown.

Re-forms damaged threads like new with full grip restored. Takes all sizes from ¼" to ¾" dia., and available for all standard threads.

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"ANY OLD IRON" IS A THING OF THE PAST

ON SETTING UP COSTS
THE
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IS EFFICIENT-FAST-
ANY HEIGHT OF CLAMP SUPPORT IN INCREMENTS OF 1/32" WITHIN SECONDS

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for lift guides and for rail fixing generally.

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in sizes ⅜" ½" ⅝" bolt

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For making sharp bends in dead straight lengths—and for forming section in all metals, in all thicknesses up to 20 ft. wide—Bronx Press Brakes are faster and more versatile than folding machines and can be tooled for punching, shearing and notching. Range of sizes from 10 to 1,000 tons pressure. Our Press Brake Specialist Engineers are available to discuss your production requirements. Do not hesitate to contact us, no matter how small or large your problem.

60 ton Series 68 Press Brake with 2' Horn Extension giving overall beam of 12'. In operation at EEC. Madras.

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No matter what make of Press Brake you use, our FREE TOOL SERVICE is at your disposal. Please send for our explanatory leaflet. Large stocks of Tools are held for immediate despatch.

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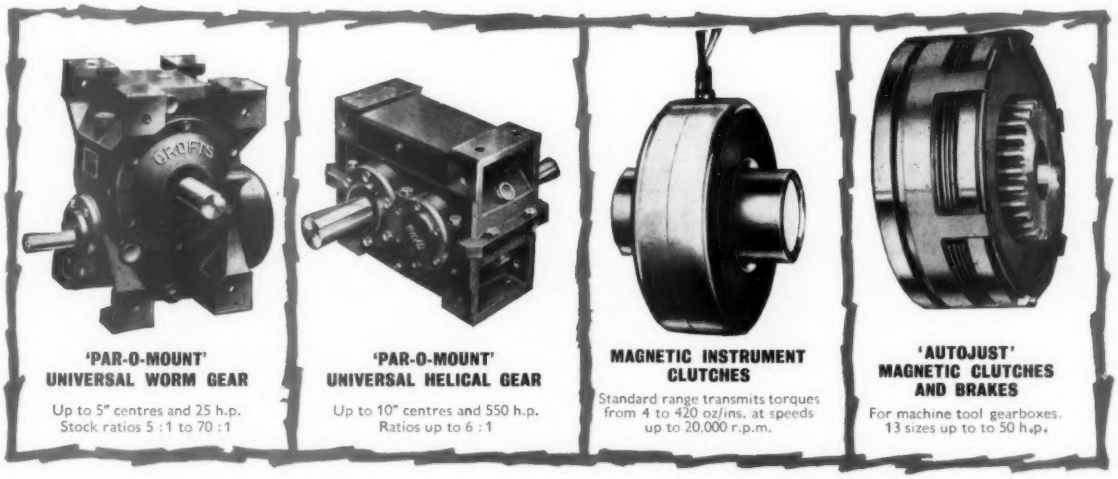

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